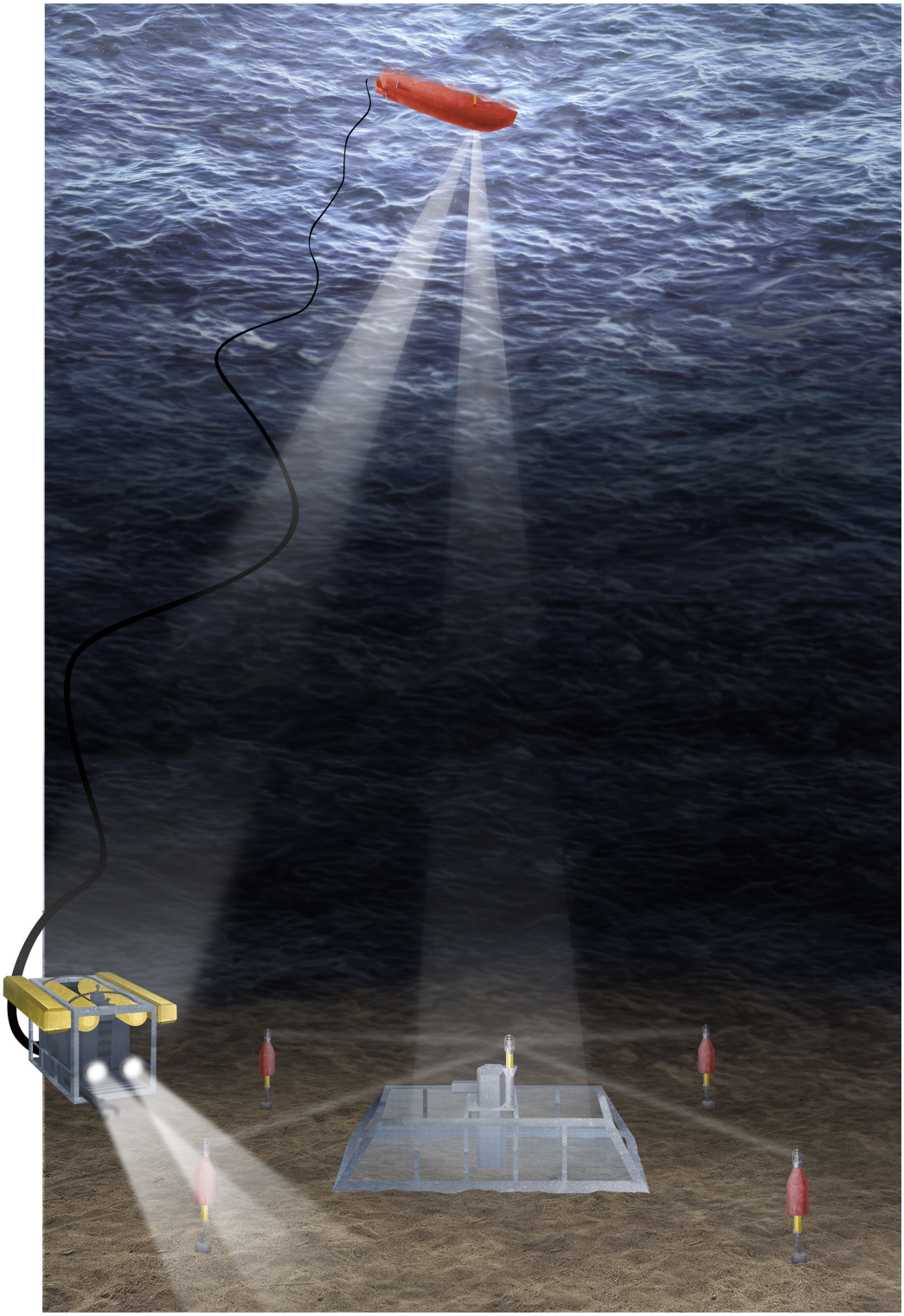
Instruction manual

KONGSBERG

HiPAP® 500 / 450 / 350 Retrofit System
High Precision Acoustic Positioning



HiPAP® 500/450/350 Retrofit

High Precision Acoustic Positioning

Instruction Manual

Document history

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A	13 June 2012	IJG/AD	AD	JEF
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Kongsberg Maritime endeavours to ensure that all information in this document is correct and fairly stated, but does not accept liability for any errors or omission.

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment. Kongsberg Maritime disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

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Additional documents

Display manual

Separate manual supplied with the display. Not a Kongsberg Maritime document.

Keyboard manual

Separate manual supplied with the keyboard. Not a Kongsberg Maritime document.

Trackball

Separate document supplied with the trackball. Not a Kongsberg Maritime document.

Cooling Unit for Retrofit Transceiver

Not a Kongsberg Maritime document.

Remarks

References

Further information about the HiPAP® 500/450/350 Retrofit system may be found in the following manuals:

- Doc. No.: 319957 APOS for HiPAP® 501/451/351/101 Instruction Manual
- Doc. No.: 850-160841 APOS Operator manual
- Doc. No.: 303490 HiPAP® Model 501/451/351/101 Instruction Manual
- Doc. No.: 311046 HiPAP® Hull units Model 501/451/351/101 Instr. Manual
- Doc. No.: 857-160639 HiPAP® Hull units Instruction manual
- Doc. No.: 325840 Cable plan and interconnections
- APOS Online Help

The reader

The maintenance information in this manual is intended to be used by a trained maintenance technician or engineer, with experience of electronic and digital circuitry, computers and electromechanical design. The level of information is based on Kongsberg Maritime's maintenance philosophy: The onboard technical personnel shall, with the help of the documentation and the system's built-in test functions, be able to identify malfunctions, locate the fault, and replace major parts, modules and components on the "Line Replaceable Unit" (LRU) level. He/she will however not attempt to repair the LRUs.

High voltage safety warning

The following safety precautions must be followed at all times during maintenance work:

- Switch off all high-voltage power supplies.
- Check the operation of any door interlocks and any other safety devices.
- Completely discharge all high-voltage capacitors.

It should be noted that interlocks and safety devices are normally located only at regular access points, and high voltages may be exposed during dismantling.

Caution *Never work alone on high-voltage equipment! Refer to general safety procedures.*

Table of Contents

1 ABOUT THIS MANUAL

Registered Trademarks

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Purpose

The purpose of this Instruction manual for the High Precision Acoustic Positioning (HiPAP) 500/450/350 Retrofit system (named HiPAP 500/450/350 Retrofit system in rest of the manual) provide the descriptions and procedures required to allow for safe and efficient use of the HiPAP 500/450/350 Retrofit system.

The manual contains descriptions, specifications, procedures and illustrations required to operate and maintain the HiPAP 500/450/350 Retrofit system.

The manual also defines the equipment responsibility, and provides general information about preservation, packing and storage of the units.

The system is described down to circuit board level, named as the Line Replaceable Units (LRUs). Block diagrams and drawings are used to simplify the descriptions.

Abbreviations

Abbreviations used in this manual:

APC	Acoustic Positioning Computer
APOS	Acoustic Positioning Operator Station
BOP	Blow Out Preventer
CG	Centre of Gravity
DP	Dynamic Positioning
DVI	Digital Visual Interface
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HiPAP®	High Precision Acoustic Positioning
HPR	Hydroacoustic Position Reference
LBL	Long Base Line
LRU	Line Replaceable Unit
MULBL	Multi-User Long Base Line
PCB	Printed Circuit Board
ROV	Remotely Operated Vehicle

RTB	Responder Terminal Block
SSBL	Super Short Base Line
SSLBL	Super Short and Long Base Line

Backup

You are advised to take a backup of all operator stations at regular intervals (1-3 months), and every time major changes have been performed in configuration and /or user settings.

Software upgrade

Caution *A system backup must be performed when the software has been upgraded.*

→ *The backup procedures are included in a separate document, the **Backup files document**, doc no 859-216300.*
This document is supplied with the APC computer.

2 HIPAP 500/450/350 RETROFIT SYSTEM

This chapter provides a brief description of the HiPAP 500/450/350 Retrofit system and configuration. It also gives a short description of each unit.

Topics

Related topics

→ *HiPAP models information on page 79*

→ *Responder option on page 90*

System desciption

The HiPAP Retrofit Kit is designed for upgrading the HiPAP 500/450/350 System (MkI) with completely new electronics and software for using Cymbal and cNODE transponders. The system can be ugraded when necessary without the need for any new cabling outside the Transceiver unit.

HiPAP 500/450/350 Retrofit system configuration

The HiPAP 500/450/350 Retrofit Kit contains all necessary HW, SW (preinstalled) and documentation to upgrade the old HiPAP MKI to same functionality as a HiPAP 501/451/351 system.

The HiPAP 500/450/350 Retrofit Kit includes an active cooling door as standard, but as an option here is an Air/Water heat exchanger cooling door with an external Recooling unit.

The HiPAP 500/450/350 Retrofit advantages are:

- No new cabling outside the Transceiver unit (uses existing MRU, Gyro and Transceiver to APOS communication cabling and Responder cabling if present).
- May use excisting operator stations.
- Very short installation time (2-3 days depending on the current installations acessibility and cooling type).
- A system 100% compatible with the existing HiPAP 501/451/351/ system (MKII).

- Can operate with cNODE Transponders in either FSK or PSK mode or even a mix of cNODE Transponders in PSK mode and old FSK Transponders.

System overview

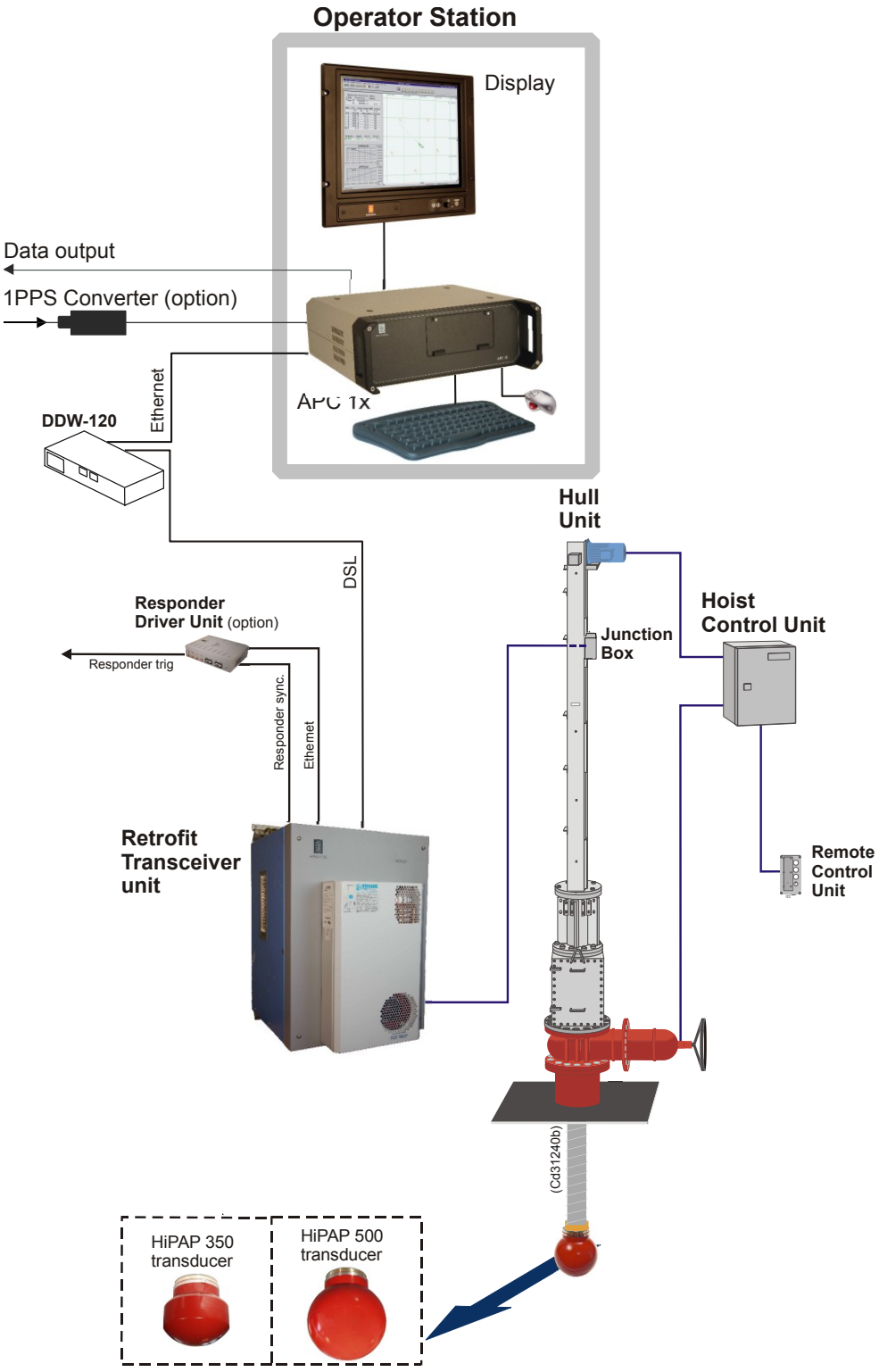


Figure 1 Single operator station

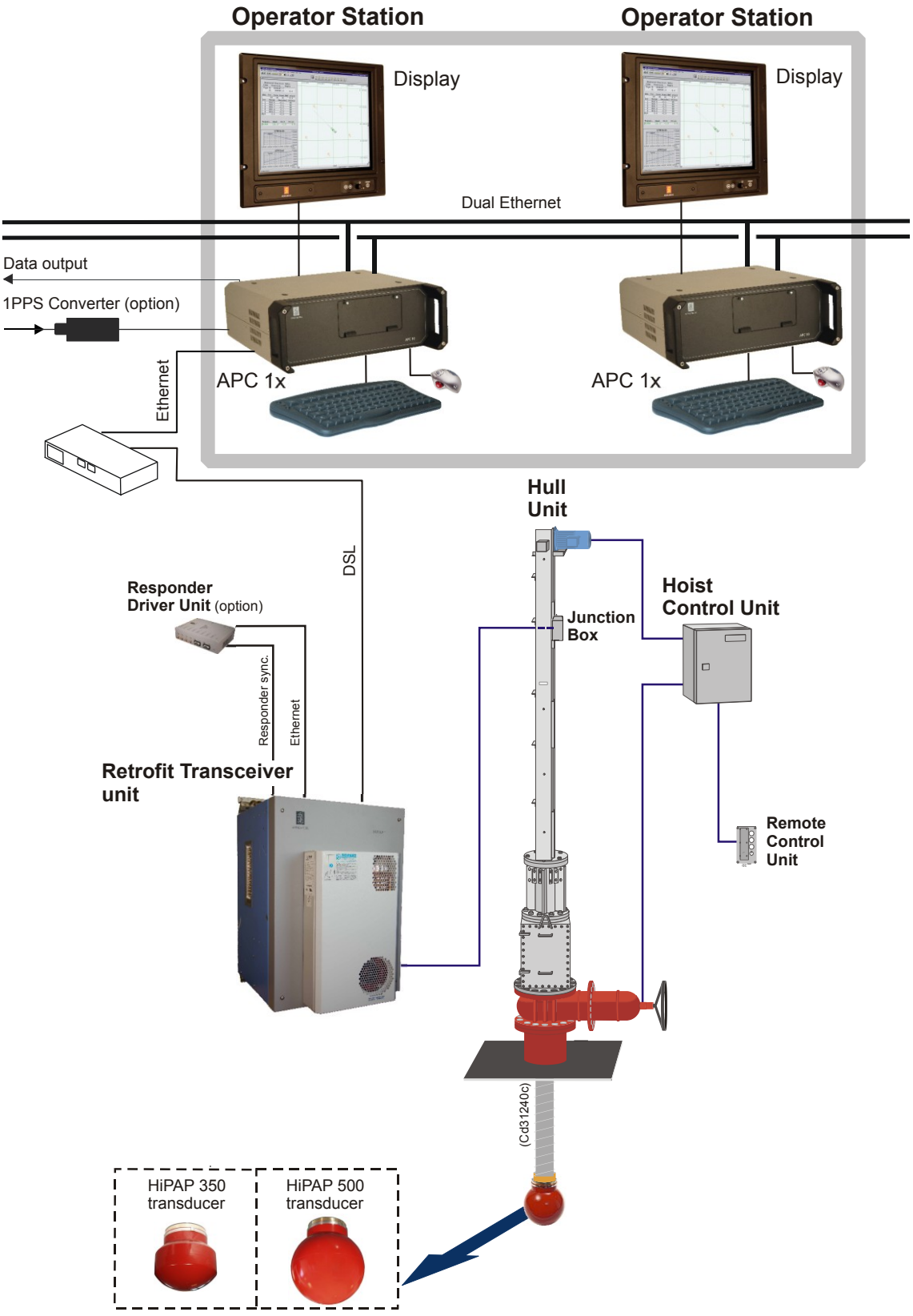


Figure 2 Two operator stations

System units

Topics

APC 1x

An APC 1x unit is a steel unit with machined aluminium sections. The same unit is used for all types of installation (desktop or rack) with additional mounting brackets or rails as required.

Figure 3 APC 1x unit - desktop version. An APC 12 is shown here

Connections

All external connections to the APC 1x unit are made via plugs located on the back of the unit.

Power

The APC 1x unit can be powered from either a 115 Vac or 230 Vac supply.

Caution *Ensure the switch is set to the power supply available before plugging the mains supply cable into the power outlet.*

The power on/off switch is located behind the hinged cover on the front panel. The switch is of the "push-for-on, push-for-off" type.

DVD recorder

The DVD recorder is placed at the front of the APC 1x behind a hinged cover.

→ *See Figure 3 on page 7.*

A DVD containing backup of the delivered APOS system is supplied at the system setup, and is included in the Backup files document.

Related topic

→ *Backup files information on page 2*

USB memory stick

USB ports for USB memory stick are located at the front of the APC 1x behind a hinged cover.

→ *See Figure 3 on page 7.*

A USB memory stick containing programs for backup and restore is delivered at the system setup. These programs can only be used when the system boots on the USB memory stick.

Keyboard

The keyboard is a standard PS/2 keyboard with US layout and back-lighting.

Figure 4 Keyboard

Trackball

The trackball is a standard Logitech trackball with a scroll wheel and two buttons.

Figure 5 Trackball

Display

→ *Refer to separate manual supplied with the display.*

1PPS converter (option)

The 1PPS converter passes the RS-232 GPS Position Data through but shapes the 1PPS pulse to a fixed pulse length and converts it from TTL level to RS-232 level.

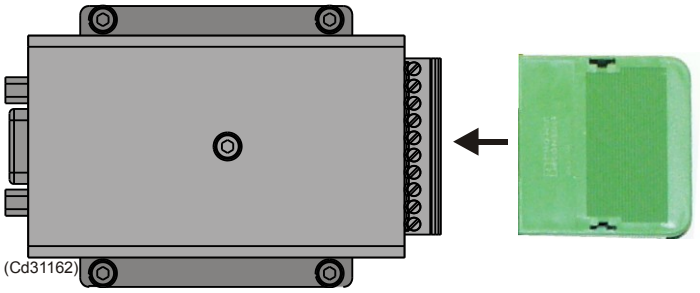


Figure 6 1PPS converter

Retrofit Transceiver unit

The Retrofit transceiver unit is made of steel and contains a rack holding the system electronics modules. The transceiver is fitted with a cooling unit on the door.

The transceiver unit is designed to be mounted on a suitable bulkhead and is fitted with vibration/shock absorbers to reduce the effects of transceiver unit vibrations.

The Retrofit Transceiver kit is delivered with:

- Electronics rack
- DIN Rail assembly
- APC 1x
- Moxa switch assembly
- Cooling unit mounted on the transceiver door

Figure 7 Retrofit Transceiver unit

- Used for the HiPAP 501 with eight (8) TRX32 boards
- Used for the HiPAP 451 with two (2) TRX32 boards
- Used for the HiPAP 351 with two (2) TRX32 boards

System upgrade

The HiPAP 451 system can be upgraded to full HiPAP 501 system performance. This is done by:

- Installation of 6 additional transmitter/receiver boards (TRX32) in the transceiver unit.
- Software upgrade.

Connections

All cables to and from the transceiver unit enter the unit through the base of the unit except the TD cable which is connected on the left side of the unit.

Power

The transceiver unit is powered from a 230 Vac UPS supply. The power switch (Main switch) is located inside the transceiver unit.

→ *Refer to figure on page 53*

If you only have 110 Vac power available, you must use a 110 Vac to 230 Vac transformer.

3 TECHNICAL SPECIFICATIONS

This chapter gives the technical specifications of the HiPAP system units.

Topics

Related topics

APC 1x

The APC 1x unit is constructed of steel and aluminium panels and machined aluminium sections.

Weight:	approximately 17 kg
Degree of protection:	IP 22

→ *Outline dimensions - see drawing in the Drawing file chapter from page 112*

Power

Voltage:	115/230 Vac
– Selector-switch beside power connector. – The power supply must be kept within ± 10% of the unit's nominal voltage (90-132 Vac / 180-264 Vac). – The maximum transient voltage variations on the main switchboard's bus-bars which could occur (except under fault conditions), are not to exceed -15% to +20% of the nominal voltage.	
Frequency:	50-60 Hz

Maximum current drawn:	5 A
Normal current drawn:	0.5 A
Nominal:	80 W

Environment

Operation temperature:	0 °C to 55 °C
Storage temperature:	-40 °C to +70 °C
Storage / operating humidity:	95% / 85% relative

Vibration

Range:	5-100 Hz
Excitation level:	5-13.2 Hz ±1.5 mm, 13.2-100 Hz 1 g

Keyboard

Weight:	0.5 kg
Cable length:	1.5 m
Degree of protection:	IP 64

→ *Outline dimensions - see drawing in the Drawing file chapter from page 112*

Trackball

→ *For more information, refer to separate manual supplied with the trackball.*

Display

→ *Outline dimensions - see drawing in the Drawing file chapter from page 112*

→ *For more information, refer to separate manual supplied with the display.*

Ethernet extender (option single net via DSL modem)

→ *For more information, refer to separate manual supplied with the Ethernet extender.*

Retrofit Transceiver unit

Data

Weight:	approximately 80 kg (depending on number of PCBs fitted)
Degree of protection:	IP 44

Power

Voltage:	230 Vac
– The power supply to a HiPAP transceiver unit must be kept within ±10% of the unit's nominal voltage (180-264 Vac). – The maximum transient voltage variations on the main switch- board's bus-bars which could occur (except under fault conditions), are not to exceed -15% to +20% of the nominal voltage. – Using 110 Vac to 230 Vac transformer (option) – see page 15	
Inrush max:	35 A Ac
Maximum current drawn:	2.5 A
Nominal:	2.1 A Ac
Frequency:	50 - 60 Hz
Nominal power consumption:	370 W/VA

Environment

Operating temperature w/Standard Cooling Unit:	0 °C to +35 °C
Operating temperature w/Water Cooling:	0 °C to +55 °C
Storage temperature:	-20 °C to +65 °C
Humidity:	15% - 95% (non condensing)

Vibration

Range:	5-100 Hz
Excitation level:	5-13.2 Hz ±1.5 mm, 13.2-100 Hz 1 g

Main power supply

Input:	230 Vac
Output:	24 Vdc, 12 Vdc, 6 Vdc, 5 Vdc, 3.2 Vdc
Input:	230 Vac
Output:	48 Vdc

110 Vac to 230 Vac transformer (option)

For installations where only 110 Vac power is available, an external transformer from 110 Vac to 220 Vac must be installed on the main power line to the transceiver unit.

Order No.:	319618
Weight:	7. 8 kg
Outline dimensions:	(300 x 250 x 155) mm

SSBL accuracy

The angular figures are errors in both axis, elevation and orthogonal.

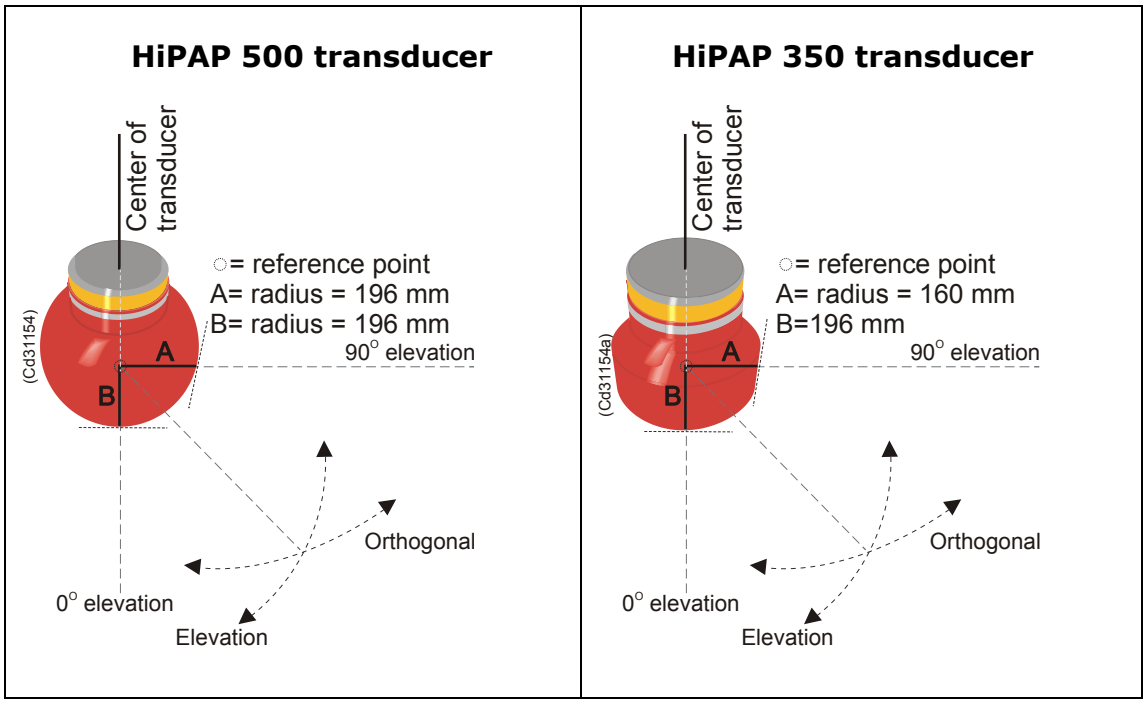
The specification is based on:

- Free line of sight from transducer to transponder.
- No influence from ray-bending.
- Signal to Noise ratio in water in the 250 Hz receiver band.
- No error from heading and roll/pitch sensors.

Transducer reference point

The reference points shown below are the origin for the position measurements.

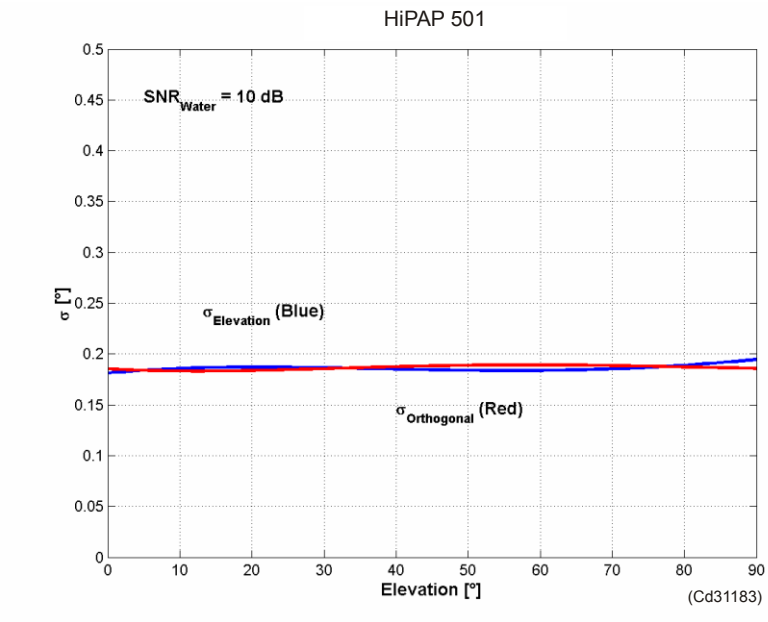
The elevation and orthogonal angles are used in the accuracy curves.



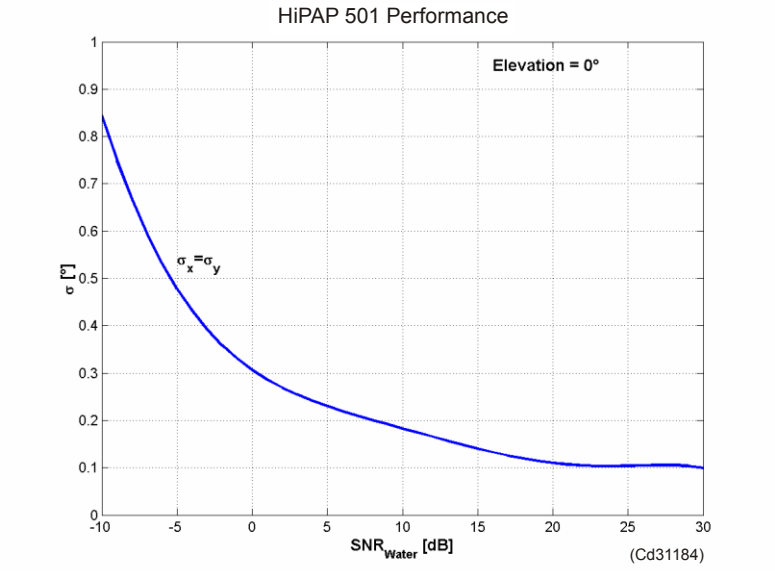
HiPAP 501 system

	HiPAP 501 Single system			HiPAP 501 Dual system		
	S/N [dB rel. 1µPa]			S/N [dB rel. 1µPa]		
	20	10	0	20	10	0
Angular Accuracy [°] (At 0° elevation)	0.12	0.18	0.30	0.085	0.13	0.21
Range Accuracy [m]	0.1	0.1	0.15	0.1	0.15	0.2
Cymbal Range Accuracy [m]	0.02	0.02	0.02	0.02	0.02	0.02
Receiver beam [°]	10			10		
Coverage [°]	±100			±100		

Accuracy curves – HiPAP 501



The figure above shows the accuracy as a function of elevation angle. The signal to noise ratio of 10 dB is in the bandwidth.



The figure above shows the accuracy as a function of signal to noise ratio. The elevation and the orthogonal angles are 0° (at vertical).

HiPAP 451 system

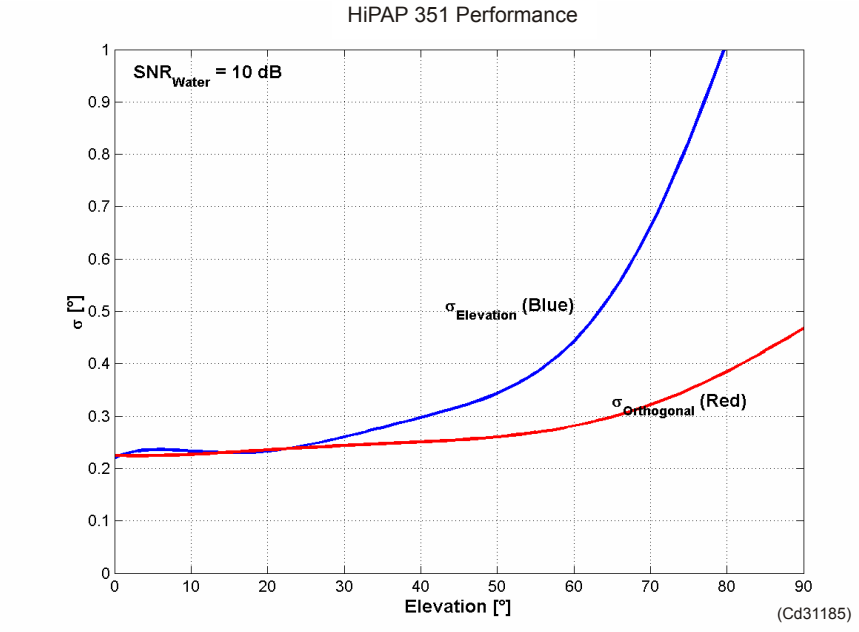
The HiPAP 500 transducer is used but with only two (2) TRX32 cards in the transceiver. HiPAP 451 has the same technical performance as HiPAP 351.

HiPAP 351 system

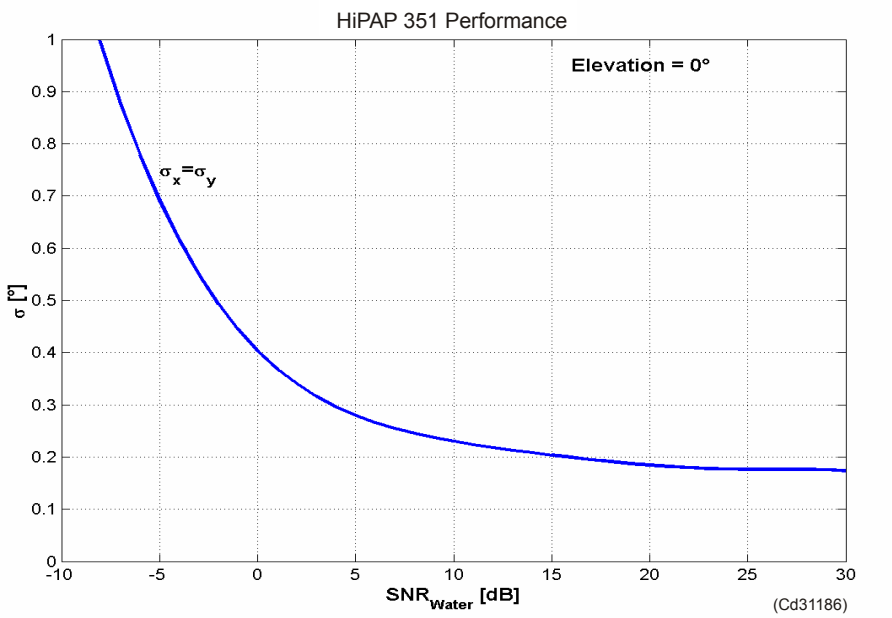
HiPAP 351/451 Single system	S/N [dB rel. 1µPa]		
	20	10	0
Angular Accuracy, 1σ [°] (At 0° elevation)	0.18	0.23	0.4
Range Accuracy, 1σ [m]	0.1	0.15	0.2
Cymbal Range Accuracy, 1σ [m]	0.02	0.02	0.02
Receiver beam [°]	15		
Coverage [°]	+/-80		

The elevation and orthogonal angles are used in the accuracy curves.

Accuracy curves – HiPAP 351



The figure above shows the accuracy as a function of elevation angle. The signal to noise ratio 10 dB is in the bandwidth.



The figure above shows the accuracy as a function of signal to noise ratio. The elevation and the orthogonal angles are 0° (at vertical).

LBL accuracy

The position accuracy for LBL operation depends on the transponder array geometry, sound velocity errors and signal to noise ratio. Range accuracy's down to a few centimetres can be obtained, while ROV and vessel positions can be calculated to within a few decimetres.

Table 1 and Figure 8 show acoustic parameters and position accuracies that are achieved in deep waters when using an array with four transponders at water depth 3000 m.

Source of random error	1-sigma FSK	1-sigma PSK (Cymbal)
Range reception with 20 dB S/N	0.15 m	0.02 m
Range reception in the transponder	0.15 m	0.02 m
Range error due to transponder movements	0.01 m	
Range error due to rig movements	0.05 m	
HiPAP Angle accuracy	0.15°	

Table 1 Sources of random errors on the acoustic measurements

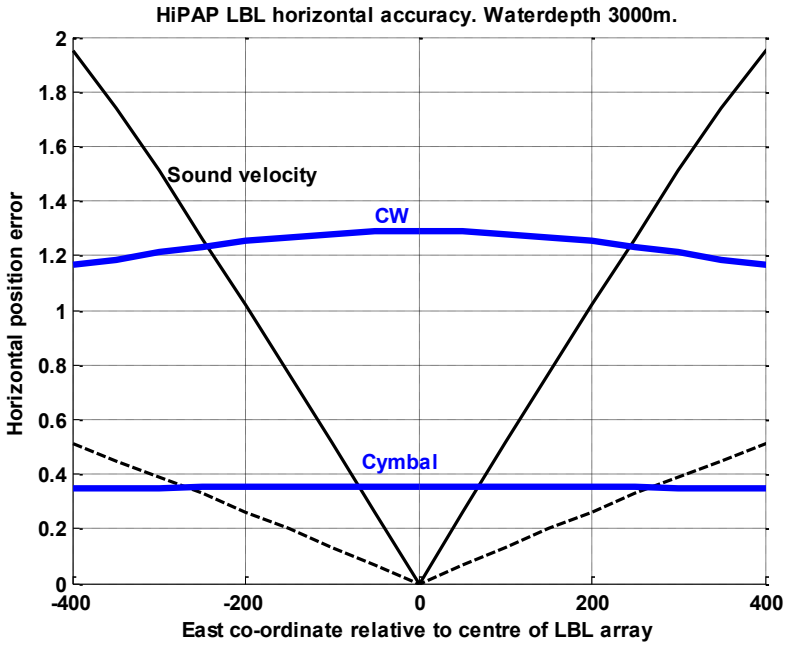


Figure 8 LBL position error in the horizontal plane as a function of the East co-ordinate. The North co-ordinate is zero. The blue lines show random error due to acoustics. Black line is systematic error due to 1 m/s wrong sound velocity settings.

The blue lines in Figure 8 show the random error in the horizontal position when the rig moves within a transponder array with four (4) transponders placed in a circle with a 500 m radius at 3000 m water depth. The lower blue line shows the expected error when the PSK (Cymbal) acoustics is used and the upper line when the old CW (FSK) acoustics is used.

The black line shows the systematic error when the sound velocity is set 1 m/s incorrectly in APOS. This error is zero in the centre of the array due to the symmetry. The LBL run time calibration should be done when the rig is in the centre of the array. Then the effect of a wrong sound velocity setting in APOS is strongly reduced, as shown with the dotted black line.

Range capabilities

The range capabilities are very dependent of the vessels noise level and attenuation of the transponder signal level due to ray bending.

- The HiPAP system will in many cases have longer range capabilities than specified below due to its narrow receiving beam.
- The figures are approximate values for guidance.

Transponder	**Transponder source level** (dB rel.1µPa ref. 1 m)	**Max Range** **(Typical, m)**
cNODE, 180º transducer	190	2000
cNODE, 40º transducer	203	3000
cNODE, 30º transducer	206	4000
Standard MPT/SPT 319	188	1500
High power SPT 324	195	2000
High power SPT 331	206	3000

The specification is based on:

- Free line of sight from transducer to transponder
- No influence from ray bending
- Signal to Noise ratio ≥ 20 dB. rel. 1µPa

4 GETTING STARTED

This chapter will provide the basic information required to get you started up with the HiPAP 500/450/350 Retrofit system.

Topics

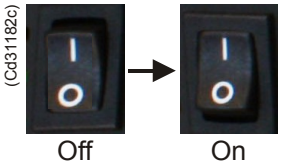
Power on/off procedures

These procedures explain how to switch the Retrofit system on and off. The operation is made using the on/off switch located on the back of the APC 1x computer.

How to switch on the power supply on the APC 1x computer

1 Make sure the main power cable is connected to the APC 1x computer and also to the power socket.

2 Switch the power button from off to on as shown below.



How to switch on the APC 1x using the standby switch

The standby switch is located under the cover on the front of the APC 1x computer.

1 Unscrew the two screws on either side of the cover.

2 Open the cover.

- The standby on/off button is located on the left hand side under the cover.

3 Push the standby button to turn on the APC 1x computer.

- A green light will start to flash when the computer is turned on.

4 Switch on the monitor. (The power on/off switch is normally located at the lower front part of the monitor.)

- First the desktop menu appears, and after some time the APOS main window appears.

How to switch off on the APC 1x using the standby switch

The standby switch is located under the cover on the front of the APC 1x computer.

1 Unscrew the two screws on either side of the cover.

2 Open the cover.

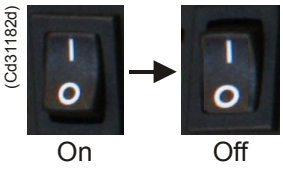
- The standby on/off button is located on the left hand side under the cover.

3 Push the standby button to turn off the APC 1x computer.

- A green light will stop flashing when the computer is turned on.

How to switch off the power supply on the APC 1x computer

1 Switch the power button from on to off as shown below.



2 The system is now completely turned off.

Using the trackball

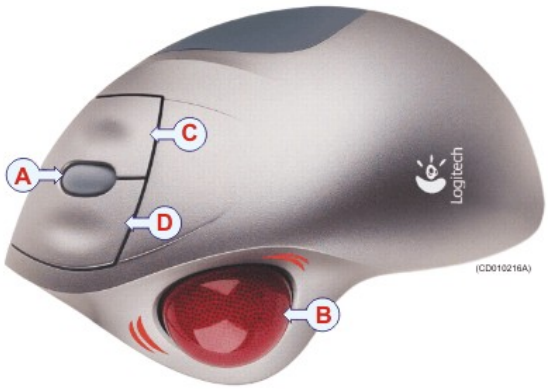


Figure 9 Typical trackball

All APOS functions are controlled with the trackball. The ball controls the movements of the cursor, and the buttons are used to click on buttons and select parameters.

A Control wheel

B Trackball

C Right mouse button

D Left mouse button

This trackball is connected to the computer, and by means of the buttons and the wheel you can control all the dialogs and parameter settings.

How to perform basic APOS operations

Observe this brief procedure to familiarise yourself with the basic operations with APOS layout and menu operations.

Note — *Normally the APOS system is kept on 24 hours a day.*

APOS Main window

1 APOS will start automatically when the APC 1x computer is turned on.

2 Once the APC computer and APOS is up and running, observe the layout of the display presentation:

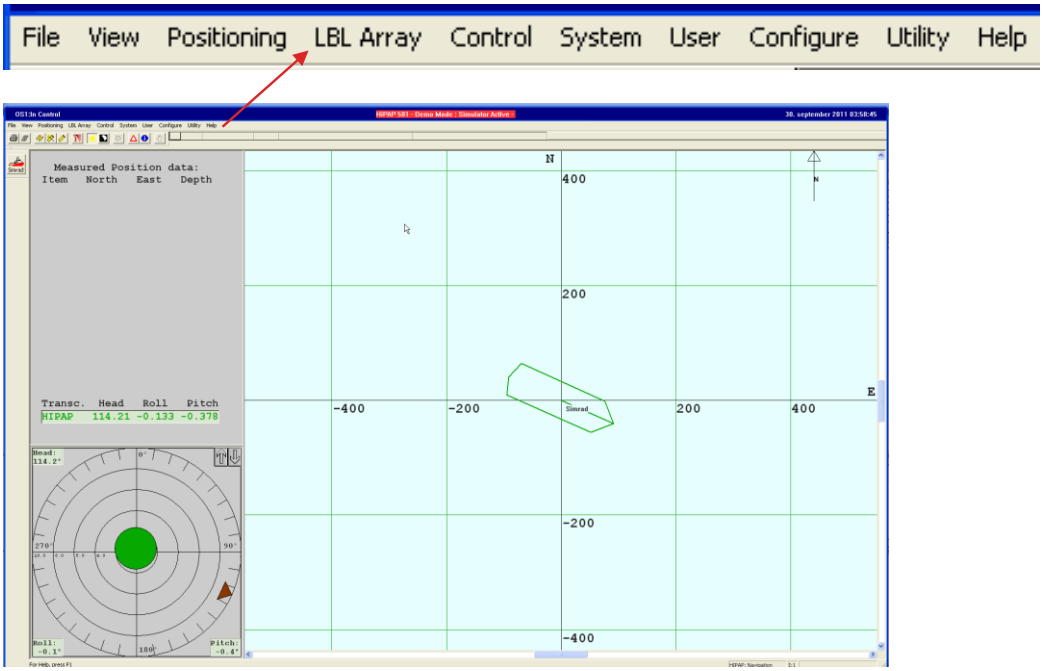


Figure 10 APOS Main window

APOS user levels

The APOS is regarding functional possibilities and operation, configured in the following two user levels:

Operator:	This level is used for the daily normal operation.
Service:	This level requires password and is for service personnel only.

The user levels can be set by selecting the User button in the top menu in APOS.

How to exit/stop the APOS system

Normally the system is kept on 24 hours a day. If a controlled shutdown is required, it is important to proceed as follows:

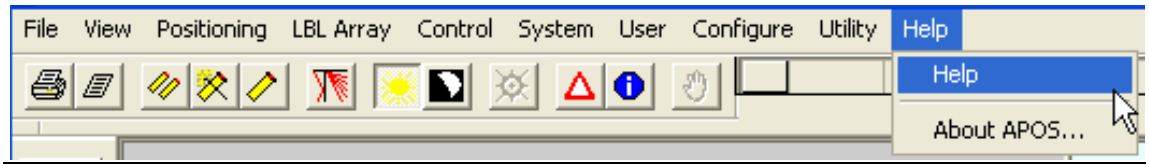
1 Select **File → Stop/Shutdown.**

2 Select **Yes**.

- The APOS software will shut down and you will return to the desktop.
- APOS can also be configured to close Window and shut down the computer when performing the above procedure.

APOS Online Help

The APOS System is equipped with a comprehensive online help system. It is available from the top menu by clicking the **Help** button. Help is also available in the sub-menues, and is the context sensitive, so you will get help on the functions in that menu.



5 SIGNAL CONNECTIONS TO TRANSCEIVER UNIT

Topics

→ *Conversion table for Transceiver connections on page 27.*

Wiring diagram for Retrofit Transceiver unit

→ *See Wiring diagram on page 118 in the Drawing file section.*

Conversion table for Transceiver connections

Signal (example)	Old connection		New connection	
	Port	Terminal	Terminal	Port
Operator station (if using DSL Modem)	Com3	TB1:1	Terminal 1	DSL port on DDW120 Ethernet Extender
		TB1:3	Terminal 2	
		TB1:5	Not Used/Spare	
		TB1:7		
		TB1:9		
Operator station (if using RS422 serial line)	Com3	TB1:1	Pin 1	One of Com6-9 on Controlling APC (Bridge/Survey room)
		TB1:3	Pin 4	
		TB1:5	Pin 2	
		TB1:7	Pin 3	
		TB1:9	Pin 5	
Operator station (using Dnet)	Com3	Not used in this configuration/Spare		
Gyro1	Com4	TB1:11	Pin 1	Transceiver APC Com6
		TB1:13	Pin 2	
MRU1	Com5	TB1:2	Pin 1	Transceiver APC Com7
		TB1:4	Pin 2	
Seapath1	Com6	TB1:12	Pin 1	Transceiver APC Com9

6 CABLES

This chapter provides basic information and general installation requirements for cables. It also includes information about transceiver units internal cabling. Most of this chapter is for reference only as the Retrofit Transceiver uses existing cables from old HiPAP transceiver.

Note

All cable connections must be made in accordance with the guidelines laid down by the vessel's classification society.

If no such guidelines exist, Kongsberg Maritime recommends that the *Det Norske Veritas (DNV) Report No. 80-P008, "Guidelines for Installation and Proposal for Test of Equipment"* be used as a guide.

Topics

→ *Cable gland assembly procedure on page 28*

→ *Basic cable requirements on page 30*

→ *Cable planning on page 33*

→ *APC 1x on page 34*

→ *GPS input signals connections on page 36*

→ *1PPS converter (option) on page 36*

→ *Retrofit Transceiver unit on page 38*

Related topics

→ *Drawings in the Drawing file chapter from page 112*

Cable gland assembly procedure

Cable glands are used whenever a cable passes through a water-tight bulkhead or into a cabinet, to seal the opening through which the cable passes and to protect the cable from abrasion on the edges of the hole. Follow the guidelines detailed here when installing cables through cable glands.

Note

There are many different types of cable gland on the market. This procedure describes the types used (now and previously) as standard in the units manufactured by Kongsberg Maritime. The cable glands are not supplied with the system.

Even though the cabinets from Kongsberg Maritime may be prepared for specific types, the installation yard will be responsible for selecting cable gland types and installing them.

General procedure

1 Ensure all the cables to be connected are completely isolated from any power sources.

- This is done by; Switch off and remove the supply fuses from any units or systems into which the cables are already connected.

2 Select the cable to be connected into the cabinet, and select the cable gland through which the cable is to pass.

Note

*A **minimum** of 5 cm (recommended 5 - 10 cm) of slack cable must be allowed, both inside and outside the cabinet, when installing cables. This is to allow for vibration damping, maintenance and measurement errors. Always double-check your measurements before taking any irreversible actions.*

---

3 Depending on whether the cable has already been installed in conduits, either.

a (installed) measure the maximum length of cable required to reach from the final cable clip outside the cabinet to the terminal blocks inside the cabinet, add 20 cm, then remove the excess cable,

or:

b (loose cable) measure the maximum length of wire required to reach from the cable gland to the terminal blocks inside the cabinet, add 20 cm and mark the cable.

Note

*The cable's outer insulation will extend into the cable gland to a point approximately 5 mm **inside** the inner surface of the cabinet wall into which the cable gland is secured.*

---

4 Taking care not to damage the screening, carefully remove the outer insulation from the required cable length.

5 Leaving an appropriate length of the screen exposed from the insulation, cut off the remainder.

Securing and terminating the cables

1 Ensure that there is 5 to 10 cm slack cable inside the cabinet - see wiring diagram.

2 Prepare and connect the cable cores to the appropriate terminals within the cabinet.

3 Secure the cable within the cabinet using cable clips.

4 Check the terminal connections against the wiring diagram to ensure they are correct.

5 Follow the same procedure for all the cables and cable glands.

Once all the cables have been fitted and checked:

1 Check the cabinet to ensure all tools and rubbish are removed.

2 Close the cabinet door.

3 Once all the system cables are connected and checked:

4 Take the appropriate safety measures, then replace the fuses and apply power to the system.

5 Perform a system test to ensure the installation has been conducted successfully.

Basic cable requirements

Cable trays

All permanently installed cables associated with the system must be supported and protected along their entire lengths using conduits and/or cable trays.

The only exception to this rule is over the final short distance (max. 0.5 m) as the cables run into the cabinets/units to which they are connected. These short service loops are to allow the cabinets to move on their shock mounts, and to allow maintenance and repair.

- Wherever possible, cable trays must be straight, accessible and placed so as to avoid possible contamination by condensation and dripping liquids (oil, etc.). They must be installed away from sources of heat, and must be protected against physical damage. Suitable shields must be provided where cables are installed in the vicinity of heat sources.
- Unless it is absolutely unavoidable, cables should not be installed across the vessel’s expansion joints. If the situation is unavoidable, a loop of cable having a length proportional to the possible expansion of the joint must be provided. The

minimum internal radius of the loop must be at least twelve times the external diameter of the cable.

- Where a service requires duplicate supply lines, the cables must follow separate paths through the vessel whenever possible.
- Signal cables must not be installed in the same cable tray or conduit as high-power cables.
- Cables containing insulation materials with different maximum-rated conductor temperatures should not be bunched together (that is, in a common clip, gland, conduit or duct). When this is impractical, the cables must be carefully arranged such that the maximum temperature expected in any cable in the group is within the specifications of the lowest-rated cable.
- Cables with protective coverings which may damage other cables should not be grouped with other cables.
- Cables having a copper sheath or braiding must be installed in such a way that galvanic corrosion by contact with other metals is prevented.
- To allow for future expansion of the system, all cables should be allocated spare conductor pairs. Also, space within the vessel should be set aside for the installation of extra cables.

Radio Frequency interference

All cables that are to be permanently installed within 9 m (30 ft) of any source of Radio Frequency (RF) interference such as a transmitter aerial system or radio transmitters, must, unless shielded by a metal deck or bulkhead, be adequately screened by sheathing, braiding or other suitable material. In such a situation flexible cables should be screened wherever possible.

It is important that cables, other than those supplying services to the equipment installed in a radio room, are not installed through a radio room, high power switch gear or other potential sources of interference. Cables which must pass through a radio room must be screened by a continuous metal conduit or trunking which must be bonded to the screening of the radio room at its points of entry and exit.

Physical protection

Cables exposed to the risk of physical damage must be enclosed in a steel conduit or protected by a metal casing unless the cable's covering (e.g. armour or sheath) is sufficient to protect it from the damage risk.

Cables exposed to an exceptional risk of mechanical damage (for example in holds, storage-spaces and cargo-spaces) must be protected by a suitable casing or conduit, even when armoured, if the cable covering does not guarantee sufficient protection for the cables.

Metallic materials used for the physical protection of cables must be suitably protected against corrosion.

Grounding

All metallic cable coverings (armour, metallic sheathing etc.) must be electrically connected to the vessel's hull at both ends except in the case of final sub-circuits where they should be connected at the supply end only.

Grounding connections should be made using a conductor which has a cross-sectional area appropriate for the current rating of the cable, or with a metal clamp which grips the metallic covering of the cable and is bonded to the hull of the vessel. These cable coverings may also be grounded by means of glands specially intended for this purpose and designed to ensure a good ground connection. The glands used must be firmly attached to, and in good electrical contact with, a metal structure grounded in accordance with these recommendations.

Electrical continuity must be ensured along the entire length of all cable coverings, particularly at joints and splices. In no case should the shielding of cables be used as the only means of grounding cables or units.

Metallic casings, pipes and conduits must be grounded, and when fitted with joints these must be mechanically and electrically grounded locally.

Cable connections

All cable connections are shown on the applicable cable plan and interconnection diagrams.

Where the cable plan shows cable connections outside an equipment box outline, the connections are to be made to a plug or socket which matches the plug or socket on that particular item of equipment.

Where two cables are connected in series via a junction box or terminal block, the screens of both cables must be connected together but not grounded.

Cable terminations

Care must be taken to ensure that the correct terminations are used for all cable conductors, especially those that are to be connected to terminal blocks. In this case, crimped sleeve-terminations must be fitted to prevent the conductor core from fraying and making a bad connection with the terminal block. It is also of the utmost importance that where crimped terminations are used, the correct size of crimp and crimping tool are used. In addition, each cable conductor must have a minimum of 15 cm slack (service loop) left before its termination is fitted.

Cable identification

Cable identification codes corresponding to the cable number shown in the cable plan must be attached to each of the external cables. These identification codes should be positioned on the cable in such a way that they are readily visible after all panels have been fitted. In addition, each cable conductor should be marked with the terminal board number or socket to which it is connected.

Cable planning

All cables must be available at the units, properly installed in cable ducting.

Note — *Special system requirements, adaptations or components may introduce special drawings and cables.*

Caution — *All power must be switched off prior to the cable installation.*

Caution — *Do not to exceed the physical limitations of the cables.*

Note — *In order to meet the EMC requirements, dedicated grounding cables have been used to connect the various system units to the vessel's ground. These cables must not be longer than 1 meter.*

APC 1x

APC 1x connections

All connections to and from the APC 1x are made at the back of the unit. The back panel is divided into three sections of connectors:

Mains power input:

- Power input

Motherboard connectors:

- Trackball (mouse)
- Keyboard PS/2 style connector
- 9-pin Delta-connector (not used)
- USB ports

PCB connectors:

- 15-pin Delta-connector, VGA video connector
- VHDC1-68 connector, PORT 1, PORT 2,... PORT 8 for serial line cable.

→ *The split cable is shown on page 122*

- Ethernet connectors for NET A and Net B
- Ethernet connector - connection to the transceiver unit
- DVI connector for Display

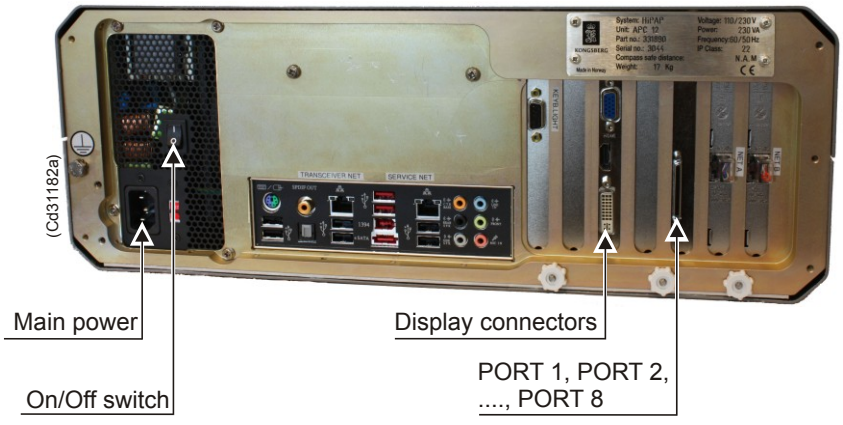


Figure 11 APC 12 rear panel

APC 1x Dual Net connection

The APC 1x connections for Dual Net are done via two connectors as follows:

- NET A
  - The RJ45 connector from NET A is connected to the Main Net A.
- NET B
  - If dual net is used, the RJ45 connector from NET B is connected to the Main Net B.

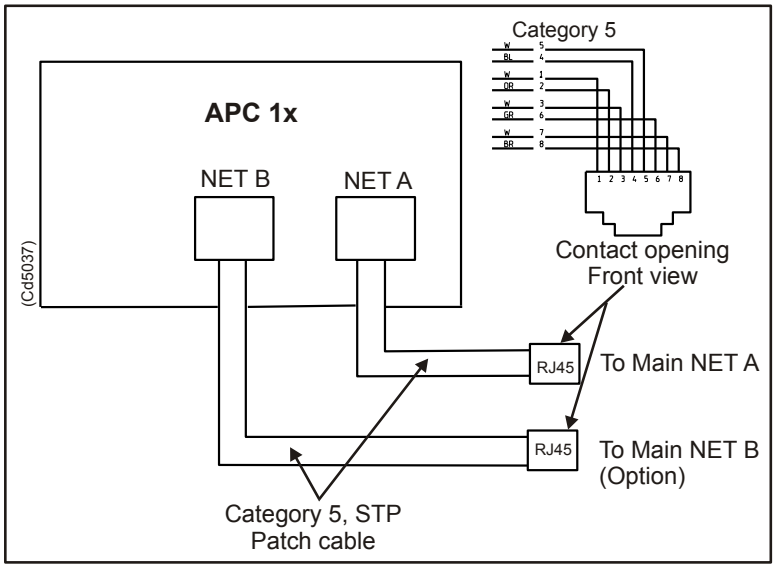


Figure 12 APC 1x Dual Net connection

→ *Cable details see Drawing file chapter from page 112.*

Depending on the Main Net implementation, the RJ45 connector could be connected directly to a HUB or a Patch panel.

If a fibre-optic net is used, a fibre-optic Ethernet converter is to be installed, and the RJ45 connector is then connected to this converter.

When no other units are connected, a Category 5 STP cable can be used directly from controlling APC 1x to the APC 1x in the HiPAP 500/450/350 Retrofit transceiver unit.

GPS input signals connections

The signal from the GPS is normally a RS-232 serial line transmitting NMEA serial data, and a TTL pulse once pr. second to synchronise the APC 1x internal timing clock to the GPS clock.

This connection is normally done as follows:

RS-232 Data	Pin 2 PORT APC 1x
1 PPS Pulse*	Pin 8 PORT APC 1x
Ground ref.	Pin 5 PORT APC 1x any PORT for RS-232 may be used.

Note

**The 1PPS pulse can have different pulse length and polarity from different suppliers of GPS receivers, so the connection described above will not always work. A 1PPS converter can be used to handle the problem.*

1PPS converter (option)

This converter passes the RS-232 Data through but shapes the 1PPS pulse to a fixed pulse length and converts it from TTL level to RS-232 level.

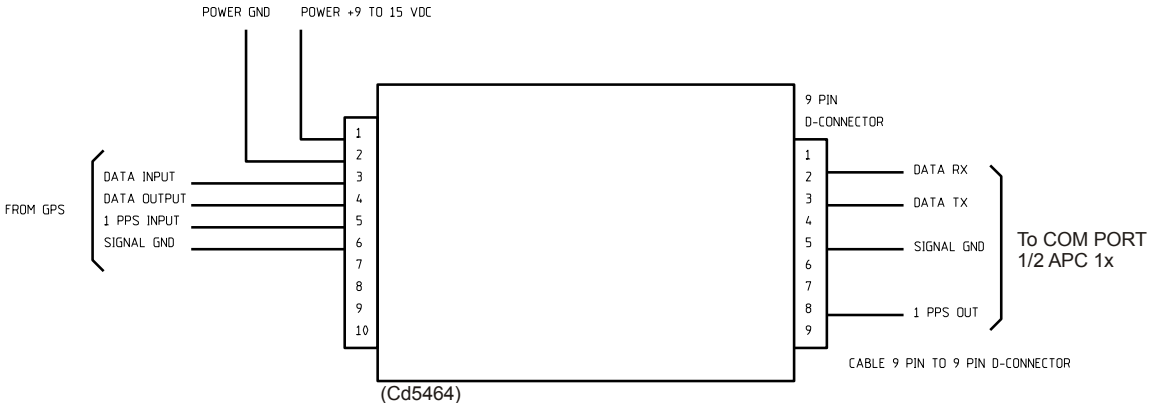


Figure 13 1PPS converter connections

A 9-pin D-connector extension cable is delivered with the converter so it can be mounted where the APC 1x is mounted.

The converter needs an external power of 9-15VDC 100 mA.

If the distance between the GPS receiver and the APC 1x is more than 10 m, we advice you to mount the 1PPS converter close to the GPS receiver.

1PPS converter internal

The 1PPS converter contains 2 DIP switch blocks.

ST14, ST15, ST16, ST17 controls the edge triggering of the 1PPS pulse.

Pos	Edge trig	Neg	Edge trig
ST16	ON	ST16	OFF
ST15	OFF	ST15	ON
ST14	ON	ST14	OFF
ST17	OFF	ST17	ON

ST13 =	NEG	RS-232	PULSE	TERMINAL 9
ST12 =	POS	RS-232	PULSE	TERMINAL 9
ST10 =	NEG	RS-232	PULSE	9 Pin D-SUB Pin 8
ST11 =	POS	RS-232	PULSE	9 Pin D-SUB Pin 8

ST3 = Connect	Data RX (Normally connected)	to 9 Pin D-SUB Pin 2
ST4 = Connect	Data TX (Normally connected)	to 9 Pin D-SUB Pin 3
ST7 = Connect	422A+ (Normally open)	to 9 Pin D-SUB Pin 9
ST2 = Connect	422A (Normally open)	to 9 Pin D-SUB Pin 6
ST6 = Connect	422B (Normally open)	to 9 Pin D-SUB Pin 4
ST1 = Connect	422B+ (Normally open)	to 9 Pin D-SUB Pin 1
ST8 = Select	Length A pulse (Normally open)	to RS-422 Converter
ST9 = Select	Length B pulse (Normally open)	to RS-422 Converter
ST5 = Connect	1PPS (Normally connected)	to 9 Pin D-SUB Pin 8

Retrofit transceiver unit

→ *Wiring diagram on page 118*

Caution — *Ensure that 10 cm of slack cable is provided outside the cabinet to allow the cabinet to move on its shock absorbers without damaging the cable.*

Retrofit transceiver internal cabling

System cables — To transceiver APC 1x - see Wiring diagram for Retrofit transceiver unit on page 118.

Transducer cable — The cable is connected to the left side of the unit and patched to the filter cards on the electronics rack.

Retrofit transceiver power cable

The power cable connects to the power socket at the base of the unit and secured to a strain relief.

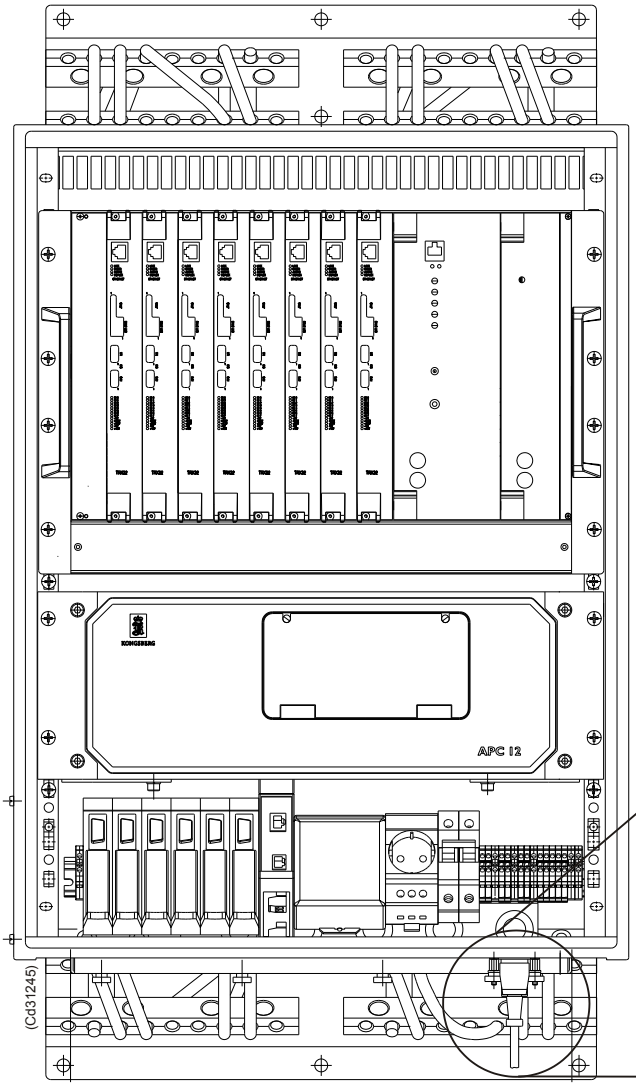


Figure 14 Power socket location on Retrofit transceiver unit

Retrofit transceiver - transducer cables

Cables connection

The cables from the TD is connected to the left side of the transceiver, and from there a patch cable connects to the filter cards in the electronics rack as shown in Figure 15. Cable 0 to Filter board 0, Cable 1 to Filter board 1, ... Cable 7 to Filter board 7.

→ *The correct order is indicated in the figure on page 54.*

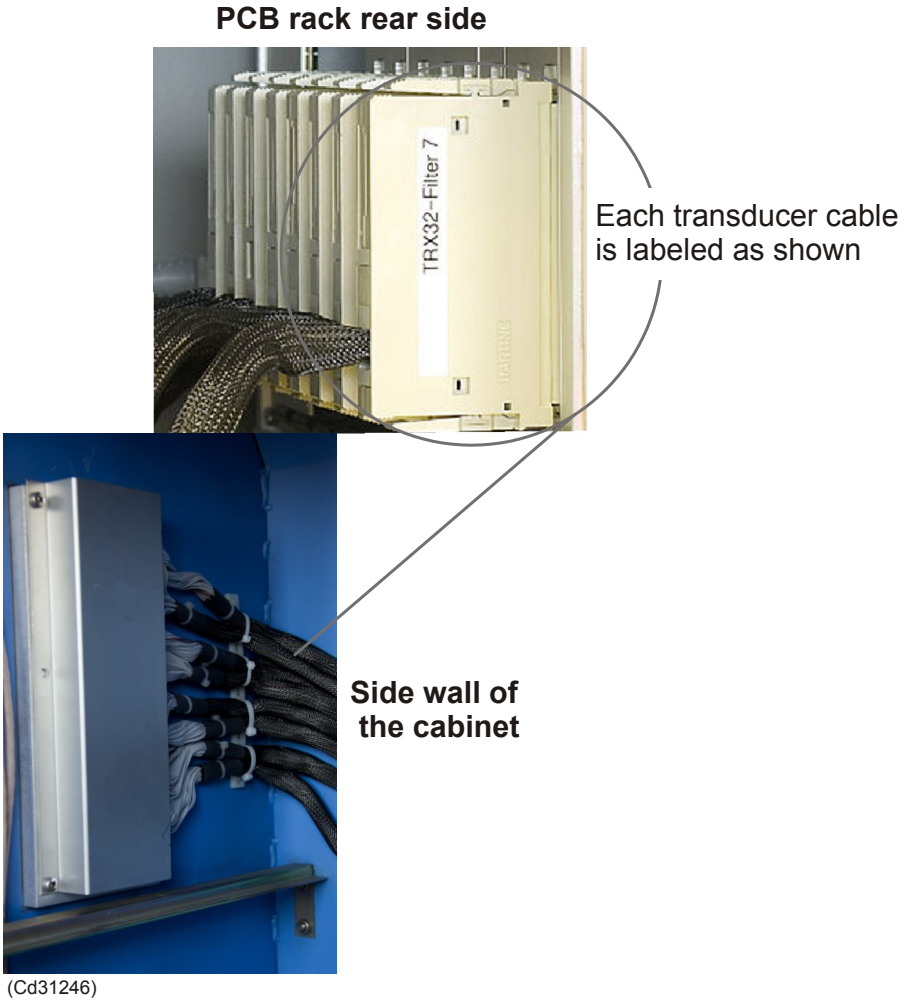


Figure 15 Transducer cable with plug inside the cabinet

Cable information

→ *Detailed information is found in the MK1 HiPAP hull units Cable layout and interconnections manual (851-160746).*

7 OPERATION

HiPAP 500/450/350 Retrofit operation

Operarating the HiPAP 500/450/350 Retrofit system is the same as the HiPAP system - see the APOS for HiPAP 501/451/351/101 Instruction Manual and the APOS Online help.

Integrated operation with Dynamic Positioning (DP) system

The HiPAP system controller APC 1x, is mounted separately and connected to the DP console via Net A and Net B.

8 MAINTENANCE

This chapter contains information on how to perform all normal preventive and corrective maintenance on the standard HiPAP system units.

- The procedures are identical for all HiPAP system.
- The technical descriptions included in this manual are intended to be used by maintenance technician and/or engineer, with experience of computer-based electronic circuitry. It is also strongly recommended that the personnel are familiar with the basic principles of hydro-acoustic technology, and in particular, positioning systems.
- The maintenance personnel are expected to replace faulty Line Replaceable Units (LRUs) (circuit boards or modules), but not to perform circuit board repairs. In order to find the faulty component, it is also expected that the maintenance personnel have access to standard electronic instruments, such as oscilloscopes and MultiMate's.

Note

If your organization (or vessel/rig) does not have the appropriate personnel available, you are strongly advised to contact either Kongsberg Maritime or your dealer for assistance.

Warning

Kongsberg Maritime accepts no responsibility for any damage or injury to the system, ship or personnel caused by drawings, instructions and procedures not prepared by Kongsberg Maritime.

This manual does not describe the maintenance of the peripheral devices (printers, plotters and sensors). For information about these items, refer to the applicable manufacturer's documentation.

Topics

→ *Keyboard on page 51*

→ *Trackball on page 51*

→ *1PPS converter (option) on page 51*

→ *Ethernet switch / Converter on page 51*

→ *Retrofit Transceiver unit on page 52*

→ *Circuit boards and units on page 62*

Related topics

→ *Backup on page 2*

→ *Software upgrade on page 2*

→ *Spare parts on page 76*

→ *Drawings in the Drawing file chapter from page 112*

Safety

Refer to standard company/vessel safety procedures before commencing maintenance work.

→ *See also High voltage safety warning on page II in this manual.*

Note — *After any maintenance work, the system must be checked to ensure it works correctly. Refer to the procedure in the Test and alignment procedures.*

Before you start

Before you start performing any maintenance, the power must be switched off, and it must be kept off while the maintenance is being carried out.

Warning — ***The maintenance engineer MUST wear a grounding bracelet, which is securely connected to the vessel's ground, at all times when performing maintenance on the units.***

1. Switch off all power to the HiPAP system, and to other systems connected to the HiPAP (Motion sensor, Heading sensor etc.).
2. For the other systems, remove the fuses if possible, and label the fuse panels with tags stating that maintenance is being carried out on the system.

Maintenance philosophy

The maintenance philosophy recommended by Kongsberg Maritime is:

- On-board maintenance should be carried out by a maintenance engineer, with the assistance of the operator. The maintenance should include the following:
  - Calibrations
  - Simulations
  - Functional tests
  - Traditional troubleshooting based on a good knowledge of the system.
- Replacement of faulty parts should be limited to the line replaceable units (LRUs) recommended in the spare parts list.

Whenever a faulty unit has been replaced, the unserviceable unit should be sent to Kongsberg Maritime, or an appointed dealer, for repair.

Error detection

If a fault is detected, the operator should call the maintenance engineer at the earliest opportunity. The operator should be issued with a standard procedure detailing how he/she is to respond to system errors or faults. This procedure should contain the following (as a minimum):

Whenever an error message appears:

- Write down any Alarm message.
- Write down the parameters currently set in the system.
- Write down a brief description of the actions currently being carried out.
- Write down the commands being executed (if any) when the error appeared.
- Write down the controls carried out (if any) when the error message appeared.
- Write down any other information that might be valuable to the maintenance engineer during troubleshooting. This also includes events not directly connected to the system (for example bad weather, excessive temperature in operations room etc.).

Verification

The first action to be performed by the maintenance engineer on receipt of a fault message must be fault verification. If the system has been closed down, it should be powered up again (unless the fault has caused serious damage to the system), and an attempt made to make the fault reappear.

- Verify the fault during continued operation.

Maintenance schedule

Maintenance routines must be performed regularly and effectively to ensure that the equipment is kept in top condition.

The chart below states the **maximum** recommended intervals at which the various routines should be performed - the intervals should be decreased if the system is used excessively.

Maintenance chart

Unit	Weekly	1-3 Month	6 Months	Reference
All units - exterior	Clean	-	Check	
All cable connections	-	-	Check	
APC 1x filter			Check/Clean	*See page 47*

Preventive maintenance

The preventive maintenance consists of keeping the units clean.

Use:

- Soft lint-free cloth
- Bucket
- Mild liquid detergent

Wet the cloth, then wring as much of the water out as possible.

Note — *Use only a damp cloth to make sure there is no possibility of water dripping into the unit.*

APC 1x computer

This section describes the internal layout, connections and replacement of the APC 1x parts.

Topics

→ *Internal layout on page 46*

→ *Opening/closing the unit on page 47*

→ *Replacement of parts on page 47*

Before you start

Note

Before you start, please read the general maintenance information on page 43.

APC 1x internal

The following units and circuit boards in the APC 1x are defined as *Line Replaceable Units* (LRUs):

- Serial line adapter board
- Two Ethernet boards
- Video adapter board
- Hard disk
- Power supply
- DVD Recorder unit

The APC 1x is based on a commercially available motherboard and the additional boards are standard plug-in circuit boards.

The placement of boards and units are shown in the figure below. The boards (not the motherboard) and units can be replaced separately.

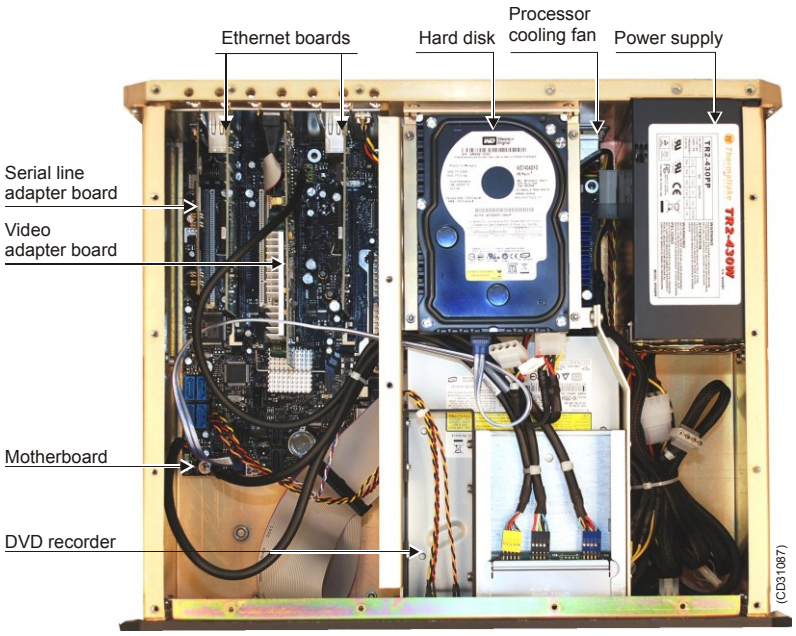


Figure 16 APC 1x -typical internal layout

Replacement of APC 1x unit parts

Topics

How to open the APC 1x unit

1 Switch off the APC 1x power.

2 Remove the power connector from the back of the unit.

3 Switch off power to all other units connected to the APC 1x (display, transceiver, motion sensor, etc).

4 Remove the 14 screws which secure the top cover onto the APC 1x (4 at the front, 4 on the top, and 3 on each side).

5 Lift the top cover clear of the APC 1x chassis.

How to close the APC 1x unit

1 Ensure all the required units and circuit boards are located correctly, and any securing screws and clips are tight.

2 Ensuring no wires or cables are trapped, carefully replace the cover onto the APC 1x.

3 Once all the screw holes are aligned, replace the 14 securing screws.

Note

Do not over-tighten the screws as you may strip the threads off either the screws or the tapped holes in the APC 1x chassis.

---

4 Remount the APC 1x unit into its rack or desktop as required.

5 Check that the supply voltage change-over switch is set correctly, and plug the mains cable into the connector on the rear of the unit.

6 Apply power to the APC 1x unit and peripherals.

Dust filter

A filter is fitted as indicated in the figure below. When required, the filter must be cleaned, to avoid blocking of the air circulation within the unit.

Dust filter types

- **Filter type SP 120**, order number see page 77.

Figure 17 APC 1x unit - filter location

Replacing APC filters

To clean the filters proceed as follows:

1 Switch off the APC 1x power.

2 Remove the top cover from the APC 1x.

3 Remove the filter.

4 Wash the filter in lukewarm water.

5 Leave it to dry before you re-install it.

6 When cleaning the filter is no longer sufficient, replace the dust filter.

Note *Use the correct filter type to ensure correct air flow!*

Replacing the hard disk

To remove the hard disk unit, proceed as follows:

1 Switch off the APC 1x power.

2 Remove the top cover from the APC 1x.

3 Use a suitable box spanner and remove the four nuts that secure the hard disk drive onto the disk drive chassis.

4 Lift the hard disk unit off the chassis.

5 Disconnect the two plugs.

6 The hard disk unit can now be removed from the APC 1x.

To replace the unit, follow the above procedure in reverse.

Note *For further details about formatting and configuration of the new hard disk, please contact Kongsberg Maritime.*

Replacing the DVD unit

To remove the DVD unit disk drive unit, proceed as follows:

1 Switch off the APC 1x power.

2 Remove the top cover from the APC 1x.

3 Use a positive screwdriver and remove the six screws that hold the disk drive chassis into the APC 1x unit.
- Four screws are located in the front of the unit behind the drive unit cover plate. Two screws are located in the rear of the unit above the connector panel.

4 Carefully lift the disk drive chassis out.

5 Remove the eight screws (four on each side) holding the DVD unit into the chassis.

6 Disconnect the two plugs.

7 The DVD unit can now be removed.

8 To replace the unit, follow the above procedure in reverse.

Replacing the power supply

To remove the power supply unit, proceed as follows:

1 Switch off the APC 1x power.

2 Remove the top cover from the APC 1x.

3 Use a positive screwdriver and remove the five screws that hold the power supply unit into the APC 1x chassis.
- Four screws are located in the rear of the unit, one is located on the side.

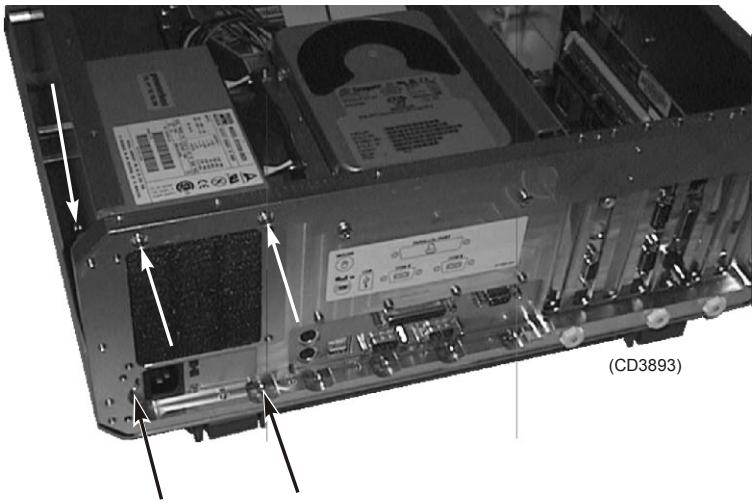


Figure 18 Location of the five power supply retaining screws

4 Carefully lift the power supply out.

5 Disconnect the plug from the motherboard.

6 The power supply can now be removed.

To replace the power supply unit, follow the above procedure in reverse. Remember to select correct voltage (if requiered).

Replacing circuit boards

→ *See overview of "standard" boards on page 63.*

General procedure

Caution *If you are to use a board different from a "standard" board, contact Kongsberg Maritime service personnel for software updates.*

To remove one of the circuit boards, proceed as follows:

1 Switch off the APC 1x power.

2 Remove the top cover from the APC 1x.

3 Insert a small positive screwdriver down through the appropriate hole in the APC 1x rear chassis plate, and remove the screw that secures the faulty circuit board into the chassis.

4 Slacken the three white plastic PCB clamping nuts located on the rear of the APC 1x chassis.

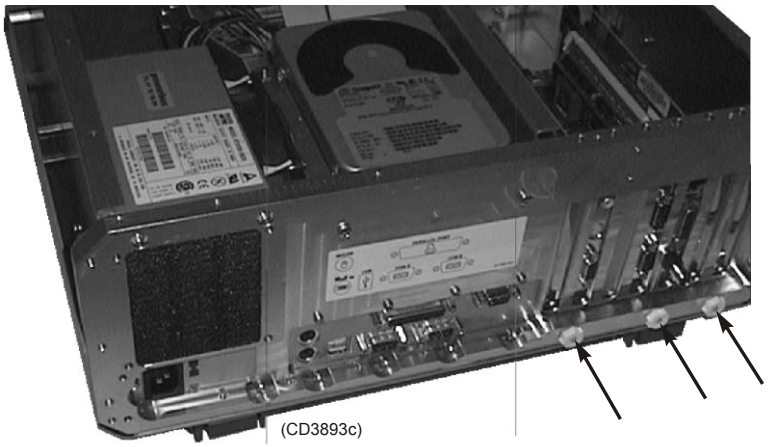


Figure 19 PCB clamp nuts

5 Carefully lift the circuit board out.

To replace the board, follow the above procedure in reverse.

Keyboard

Under normal conditions, maintenance is not required, apart from keeping the unit clean. If the keyboard is not functioning properly, the unit must be replaced.

Trackball

Under normal conditions, maintenance is not required, apart from keeping the unit clean. If the trackball is not functioning properly, the unit must be replaced.

1PPS converter (option)

Maintenance is not required under normal conditions apart from keeping the unit clean. If the 1PPS converter is not functioning properly the unit must be replaced.

→ *1PPS converter information, see page 10*

Ethernet extender (option single net via DSL modem)

Maintenance is not required under normal conditions apart from keeping the unit clean. If the Ethernet extender is not functioning properly, the unit must be replaced.

→ *For more information, refer to separate manual supplied with the ethernet extender.*

Removal

1 Disconnect all power to the unit.

2 Remove all cables.

3 Remove the unit (lift until the upper part releases from the DIN-rail).

Replacement

In principle, replacing the Ethernet extender is to perform the steps in paragraph *Removal* in reverse order.

Retrofit Transceiver unit

This section describes the internal layout, connections and replacement of the Retrofit Transceiver unit parts.

Topics

→ *Retrofit Transceiver unit internal layout on page 53.*

→ *Replacement of parts on page 54*

If more information is required, contact Kongsberg Maritime for service.

Before you start

Note — *Before you start, please read the general maintenance information on page 43*

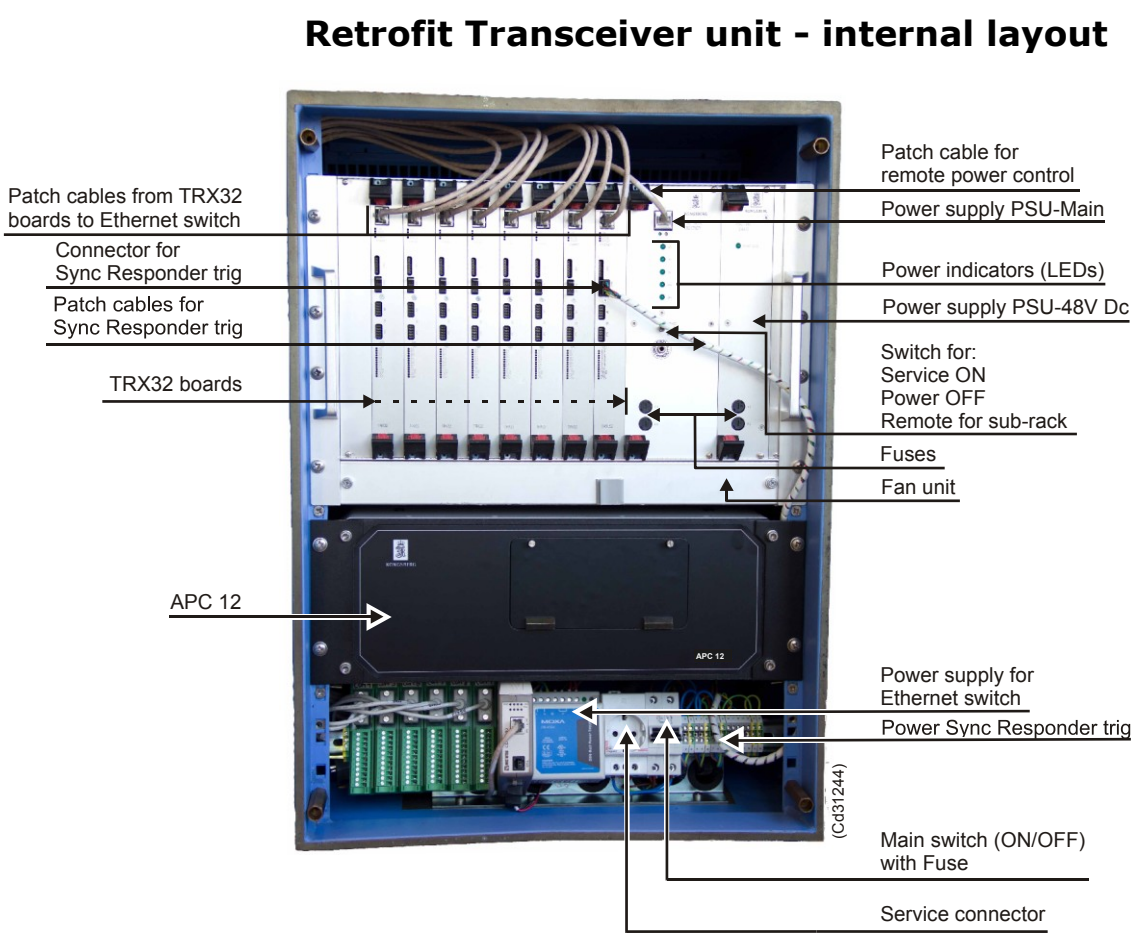


Figure 20 Retrofit Transceiver unit - internal layout

The following parts contained within this transceiver unit are defined as *Line Replaceable Units* (LRUs):

TRX32 boards	-	Transmitter/Receiver board - up to eight (8) boards, depending on the system configuration. This is a plug-in unit.
TRX32 Filter boards	-	Transmitter/Receiver filter board - up to eight (8) boards, depending on the system configuration. This is a plug-in unit.
Power supply PSU-Main	-	Provides the voltages required by the TRX32 boards, and carries a “power on” indicator. This is a plug-in unit.
Power supply PSU-48 V Dc	-	Provides power to the transmitters and carries a “power on” indicator. This is a plug-in unit.
Fan unit	-	For air circulation inside the transceiver unit.
D-sub to terminal blocks	-	Used for connecting externally supplied signals.
Ethernet switch PSU	-	The DR-4524 DIN-rail 24 Vdc Power Supply is used.
Ethernet switch	-	Ethernet to Fibre-optic converter. Redundant Ethernet

possibility.

Ethernet extender - Westermo DDW-120 Ethernet SHDSL Extender is used for this purpose.

Cooling unit - This unit is mounted on the transceiver door. It cools the air inside the transceiver.

→ *Separate manual is supplied with the unit. This is not a Kongsberg Maritime document.*

APC 1x computer - Runs the HiPAP programme and communicates with the controlling APC1x computer (on the Bridge or in the Survey room).

Retrofit Transceiver unit, PCB rack

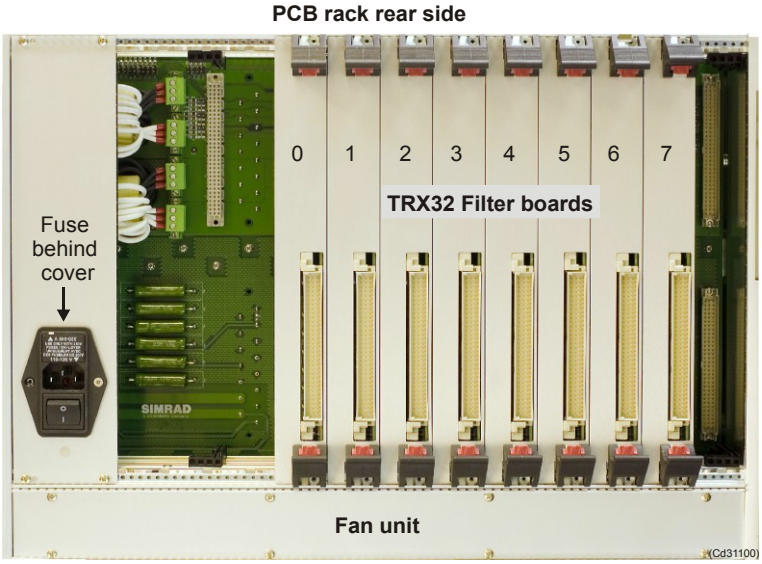


Figure 21 Retrofit Transceiver unit, PCB rack

Replacement of Retrofit Transceiver unit parts

Topics

→ *How to open/ close the door on page 55*

→ *Replacement of the TRX32 boards on page 55*

→ *Replacement of the TRX32 filter boards on page 57*

→ *Replacement of the power modules on page 58*

→ *Replacement of the Ethernet switch on page 59*

→ *Replacement of the power unit for Ethernet switch on page 59*

→ *Replacement of the terminal blocks on page 60*

→ *Replacement of the fans on page 58*

→ *Replacement of the fuses on page 61*

If more information is required, contact Kongsberg Maritime for service.

Before you start

Note

Before you start, please read the general maintenance information on page 43.

How to open/close the door

Before performing any replacements, you must open the transceiver unit front door. To do this:

1 Loosen the four captive screws in the corners of the door.

2 Lift the door off.

- Remember to disconnect the power for the Cooling unit before putting the door in a safe place.

To close the door, proceed in reverse order!

Circuit boards basics

→ *TRX32 boards location, see the figure on page 53.*

→ *TRX32 filter boards location, see the figure on page 54.*

The circuit boards in the transceiver unit rack are all plug-in modules. The boards are locked into position by two ejectors.

TRX32 Transceiver board visual inspection

→ *Refer to page 73*

Replacement of a TRX32 Transceiver board

Before you start, read the following:

- Before you start removing any board/unit on page 43.
- How to open/close the Transceiver unit door on page 55.

Removal

1 Switch off the transceiver unit using the Main switch.

2 Locate the faulty board.

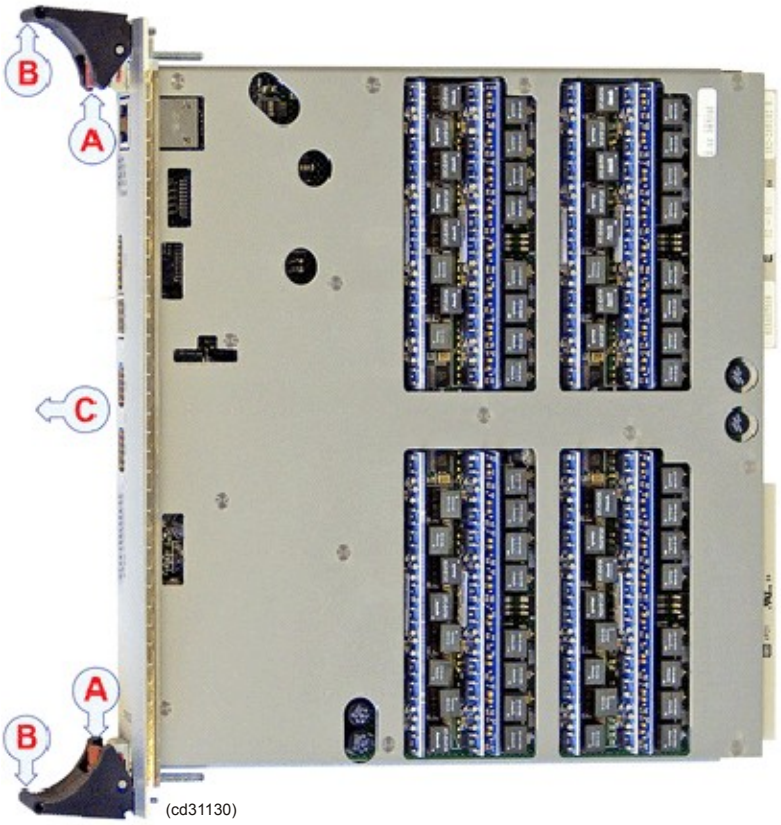


Figure 22 TRX32 Transceiver board

3 Note the locations of, and remove, any cable connected to the front of the board.

4 Grab the board ejectors with both hands (**B**), and press down the red knob (**A**) on the board ejectors.

- The ejectors are now free.

5 To loosen the board, push the top ejectors (**B**) upwards, and the bottom ejector (**B**) downward.

6 Then pull the board straight out (**C**).

7 Place the board into an anti-static plastic bag and place it on a clean, stable work-bench where it cannot come to any harm.

Replacement

In principle, replacing a board is to perform the steps in *Removal a TRX32 board* in reverse order.

1 Grab the board ejectors with both hands, and push the board straight in.

2 Lock the board in place by pushing the top locking handle down, and pull the bottom locking handle up.

3 Insert the front mounted Ethernet cable and other front mounted cables.

4 Once all the boards are in position, re-apply power as required.

5 Close the transceiver unit front door.

- Remember to plug in the power for the cooling unit befor closing door.

Replacement of a TRX32 filter board

Before you start, read the following:

- Before you start removing any board/unit on page 43.
- How to open/close the Transceiver unit door on page 55.

Removal

1 Switch off the transceiver unit using the Main switch.

2 To access the filter boards:

a Open the access door to remove a filter board.

→ *Same principle as removing a TRX32 board, see procedure on page 55.*

or

b Removing the PCB rack.

→ *How to remove the PCB rack, see procedure on page 58.*

Replacement

In principle, replacing a power unit is to perform the steps in paragraph *Removal* in reverse order.

Replacement of units

Before you start, read the following:

- Before you start removing any board/unit on page 43.
- How to open/close the Transceiver unit door on page 55.

→ *Units location, see the figure on page 53.*

PCB rack

Removal

The unit is mounted with four (4) screws.

Remove the module as follows:

1 Switch off the transceiver unit using the Main switch.

2 Remove the cables (**C**) at the front of the rack.

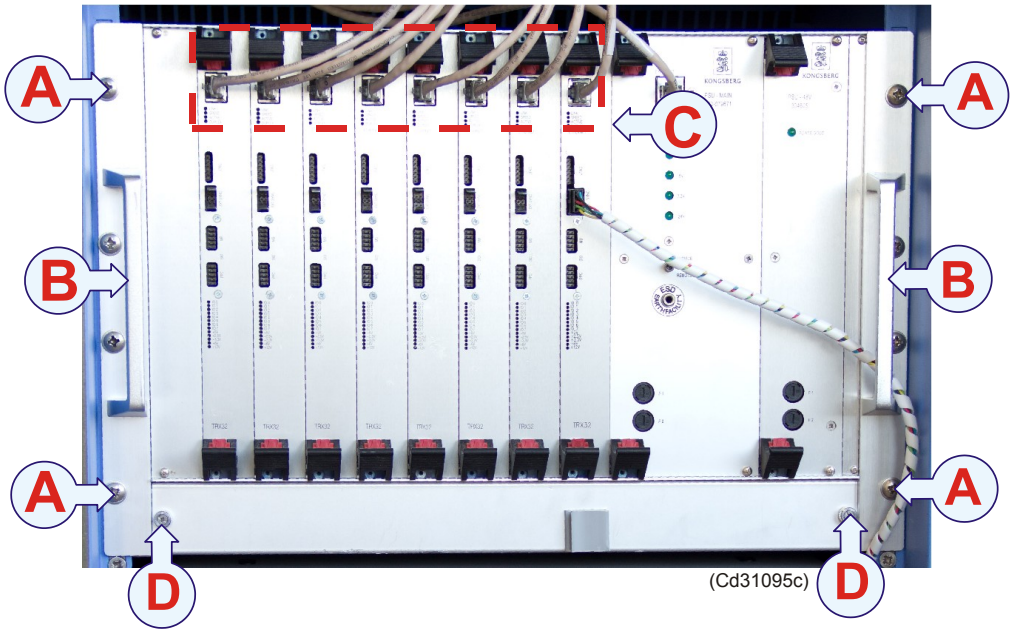


Figure 23 Retrofit Transceiver unit PCB rack

3 Open the access door on the left side and disconnect the transducer cables from the filter boards.

4 Remove the four screws (**A**).

5 Grab the two handles (**B**) and pull the rack gently out.

6 When the rack is almost pulled out, support the rack and lift it out.

7 Place the rack on a suitable workbench.

Replacement

In principle, replacing the rack is to perform the steps in paragraph *Removal* in reverse order.

Power modules

Removal/ Replacement

→ *Same principle as removing/ replacing a TRX32 board, see procedures starting on page 55.*

Fan unit

Removal

1 Switch off the transceiver unit using the Main switch.

2 Remove the two screws (**D**) in the front.

→ *See Figure 23 on page 58*

3 Pull the lower edge down and out.

Replacement

In principle, replacing the fan unit is to perform the steps in paragraph *Removal* in reverse order.

Ethernet switch

Removal

The Ethernet switch/Converter is located on a bracket at the bottom left corner of the transceiver unit.

1 Switch off the transceiver unit using the Main switch.

2 Remove all cables.

3 Remove cover for old intake filter from underneath the transceiver unit.

4 Loosen the 4 screws holding the Ethernet switch bracket and remove the Ethernet switch.

Replacement

In principle, replacing the ethernet Switch is to perform the steps in paragraph *Removal* in reverse order.

Note *The new Ethernet switch/Converter must be configured.*

Configuration of Ethernet switch

The new Ethernet switch must be configured. You will find the configuration information on the Operator station (APC 1x). Ref:

C:\Install\moxa\moxaconfig.rtf

Power unit for Ethernet switch

Removal

The Ethernet switch power unit is located on the support rail at the bottom of the transceiver unit. To remove/replace the unit:

→ *Same principle as for the Ethernet switch.*

Replacement

→ *Same principle as for the Ethernet switch.*

Ethernet extender

Maintenance is not required under normal conditions apart from keeping the unit clean. If the Ethernet extender is not functioning properly, the unit must be replaced.

→ *For more information, refer to separate manual supplied with the ethernet extender.*

Removal

1 Switch off the transceiver unit using the Main switch.

2 Remove all cables.

3 Remove the unit (lift till the upper part releases from the DIN-rail).

Replacement

In principle, replacing the Ethernet extender is to perform the steps in paragraph *Removal* in reverse order.

S-sub to Terminal block

Removal

The D-sub to terminal block modules are located on the support rail at the bottom of the transceiver unit. Remove the module as follows:

1 Switch off the transceiver unit using the Main switch.

2 Remove the power cables in to the cabinet.

3 Disconnect the terminal block module.

4 The module is snapped on. To remove it, use a small screwdriver to release the lock-tab in the upper end, and pull it directly out from the support rail.

Replacement

To replace a terminal block module, proceed as follows:

1 Align the lower part of the module on the support rail.

2 Press the upper part of the module until it snaps into place.

Fuses

The transceiver unit is powered via a Main switch mounted on the support rail at the bottom of the transceiver unit. The Main Switch acts as both a circuit breaker and a fuse, and it trips at 10 A.

Fuse replacement

1 Switch off all external units and systems connected to the HiPAP system.

2 Open the transceiver unit front door.

3 Switch off power to the unit using the Main switch.

4 Replace the blown fuse(s) with a fuse with correct size and type.

→ *See the table below for more information.*

5 If the Main switch has tripped, remake the switch.

Caution *Release the switch immediately. It is made so it can trip again if necessary.*

---

6 First, return power to the HiPAP system, then to the other external units.

Caution *If, when a fuse is replaced, it blows or trips again when power is switched on to the system, a more serious fault exists. Do not replace the fuse(s) a second time till the fault has been found and corrected.*

---

7 Close the transceiver unit front door.

Fuses

Unit	Fuse location	Fuse replacement	Fuse description
Main switch	*Location, see figure on page 53.*	N/A	The fuse is a circuit breaker, and it trips at 10 A (K10A type).
TRX32 Filter board power connector with ON / OFF switch.	*Located at the rear side of the PCB rack, see figure on page 54.*	To access the fuse, open the access door. The fuse is placed behind a cover, on top of the power connector.	**Fuse** - 250 V, 6.3 A, slow-blow.
Power PSU-Main 48 Vdc	*Location, see figure on page 53.*	The fuse is contained in a fuse holder. To replace the fuse: Use a screwdriver, press down and turn the holder half a turn. Take the holder out and remove the fuse. Replace the fuse in reverse order!	F1 and F2. **F1** - 250 V, 6.3 A, slow-blow. **F2** - 250 V, 6.3 A, slow-blow.
Power unit for transmitters PSV-Main	*Location, see figure on page 53.*	The fuse is contained in a fuse holder. To replace the fuse: Use a screwdriver, press down and turn the holder half a turn. Take the holder out and remove the fuse. Replace the fuse in reverse order!	F1 and F2. **F1** - 250 V, 8 A, slow-blow. **F2** - 250 V, 8 A, slow-blow.

Caution *Always use the correct size and type of fuse. Irreparable damage may be caused to the transceiver unit if the wrong fuse (or anything else) is used.*

Circuit boards and units

This section provides information on the circuit boards and power units. Switch settings and links are described where necessary.

Topics

→ *APC 1x on page 63*

→ *Transceiver units on page 66*

APC 1x circuit boards and power unit

This section provides a short description of the circuit boards and power unit contained within the APC 1x.

Caution

The APC 1x may be set up with various configurations of boards and units, depending on the actual delivery. The boards/units may also vary depending on availability. The "standard" boards and units are described here.

Topics

→ *Serial line adapter board on page 63*

→ *Ethernet board on page 64*

→ *Video adapter board on page 64*

→ *Power supply on page 65*

BlueStorm/PCI serial adapter board

Manufacturer; http://www.connecttech.com

This serial adapter board is a commercially available board. It is equipped with:

- four RS-232
- four RS-422.

Several cards can be used in the computer to increase the number of outputs available.

BlueStorm/PCI installation for Windows XP

The BlueStorm/PCI board uses a specific driver on Windows XP. This device driver provides an interface between the Windows XP operating environment and a BlueStorm/PCI adapter. Under Windows XP you can install a maximum of 256 serial ports.

- Install the driver
- Test the board

→ *Refer to the BlueStorm/PCI User Manual.*

Switches

The BlueStorm/PCI board holds no switches.

Links

The BlueStorm/PCI board holds no links.

Connectors

- One PCI connector
- One VHDC1-68 female connector for the serial lines.

→ Cable details on page 122

Ethernet board

Manufacturer; http://www.intel.com

The Desktop Adapter board is a commercially available Ethernet board. It is compatible with Fast Ethernet and Ethernet.

This is a “Repair-by-replacement” item. If the board develops a fault, the entire board must be replaced.

LEDs

The PRO/1000 GT Desktop Adapter board holds no LEDs.

Switches

The PRO/1000 GT Desktop Adapter board holds no switches.

Links

The PRO/1000 GT Desktop Adapter board holds no links.

Connectors

- Three edge connectors to connect it into the motherboard.
- One standard RJ-45 for external Ethernet connection.

ATI Radeon Video adapter board

Manufacturer; http://www.ati.com

The ATI Radeon is a commercially available video adapter board.

This is a “Repair-by-replacement” item. If the board develops a fault, the entire board must be replaced.

LEDs

The ATI Radeon board holds no LEDs.

Switches

The ATI Radeon board holds no switches.

Links

The ATI Radeon board holds no links.

Connectors

- Three edge connectors to connect it into the motherboard.
- One standard 15 pin D-connector for the monitor.
- One standard DVI connector for the monitor.

Power supply

The power supply is a commercially available power supply.

The AC power supply enables the computer to be powered from a 115/230 Vac mains supply.

The power supply is a sealed unit. In the event of malfunction, replace the unit.

Input voltage

The correct range of ac input voltage in the working environment is selected by the slide switch.

- 230 Vac (minimum: 180 V / maximum: -265 V)
  or
- 115 Vac (minimum: 90 V / maximum: -135 V)
- The maximum Dc output current of +5V: 2.2A

Configuration of power distribution

+3.3 V	32 A	0.3 A	1. Max. continuous total Dc output power shall not exceed 350 W. 2. Max. output combined on +5 V and +3.3 V shall not exceed 185 W.
+5 V	32 A	0.3 A	
+12 V	26 A	1.5 A	
-5 V	1 A	0 A	
-12 V	1 A	0 A	
	2.2 A	0.1 A	

Transceiver units

This section provides a short description of the circuit boards and power supply units contained within the transceiver units.

The following circuit boards and units are described:

Common circuit boards

Topics

→ *TRX32 transceiver board on page 66*

→ *TRX32 filter board on page 74*

Retrofit Transceiver unit

→ *Location of units, see Figure 20 on page 53.*

Topics

→ *Power supplies - contact Kongsberg Maritime*

→ *Ethernet switch - contact Kongsberg Maritime*

→ *Fan unit - contact Kongsberg Maritime*

→ *Cooling unit - refer to separate manual supplied with the unit*

TRX32 Transceiver board

The TRX32 board is a 32 channels multi-frequency transmitter and receiver circuit board.

The board is normally covered by a protection, screening and strengthening plate, which covers most of the component side of the board.

The board is locked in position by two board ejectors.

Function

The TRX32 board holds a total of 32 transmitters and 32 receivers, and each transmitter/receiver pair is connected via the cable to a specific element in the transducer. The board also contains computing power.

Configuration

The TRX32 board is fitted with LEDs to monitor its operational status, as well as links and switches to set it up for various applications.

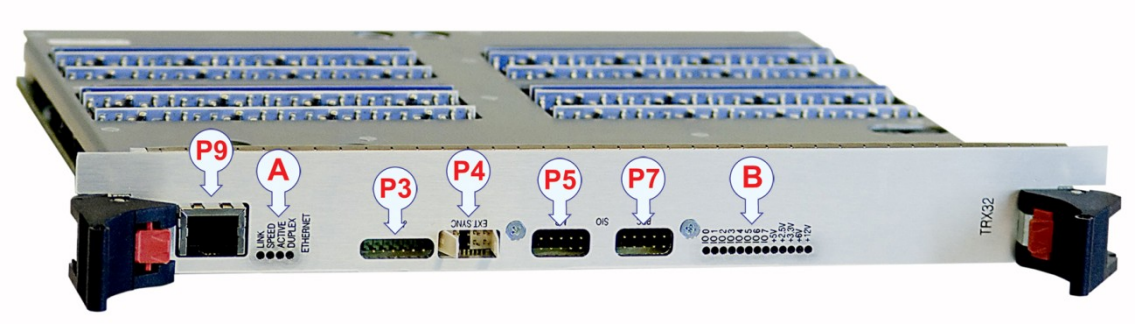


Figure 24 TRX32 Front panel

- **A** - LEDs to monitor Ethernet activity
- **B** - LEDs to monitor input/output activity and power supplies
- **P9** - Ethernet connector
- **P3** - JTAG connector
- **P4** - External synchronisation
- **P5** - Serial input/output for development and debugging purposes
- **P7** - Serial input/output for development and debugging purposes

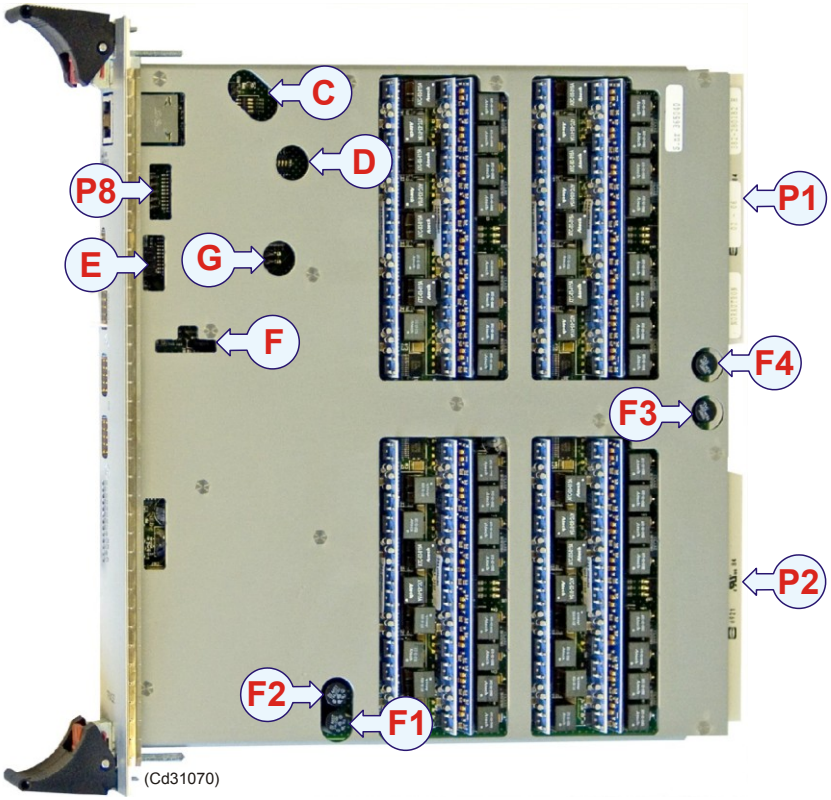


Figure 25 TRX32 Top view

- **C -** Switch SW1
- **D -** Switch SW2
- **E -** Links ST1, ST2, ST3 and ST4
- **F -** Links ST5, ST6, ST7 and ST8
- **G -** Links ST9 and ST10
- **P1 -** Backplane connector power and signals
- **P2 -** Backplane connector to transducer element
- **P8 -** JTAG connector

Fuses:

- **F1** - 12 V fuse 4 A 250 V
- **F2** - 6 V fuse 4 A 250 V
- **F3** - High voltage fuse 6.3 A 250 V
- **F4** - High voltage fuse 6.3 A 250 V

LEDs

→ *LEDs location, see Figure 24 on page 66.*

Ethernet LEDs (pos A)

Four LED's display Ethernet operating mode and activity as follows:

LED	Function
LINK (green)	The connection to the external device is OK
SPEED (yellow)	The detected bit rate is 100 Mbit/s
ACTIVITY (green)	Flashing light indicates transmit and receive activity
DUPLEX (yellow)	The interface operates in full duplex mode

Processor activity and error conditions LEDs (pos B)

The front panel includes 8 yellow LEDs (IO0-IO7) displaying processor activity and various error conditions, and 5 LEDs indication power supply status.

LED	Function
IO0-IO3 (yellow)	Show the PowerPC boot sequence
IO7 (yellow)	Indicates that the MicroBlaze program has successfully started
5 (green)	The 5 green LEDs indicate that the internal supply voltages are OK

- **IO 0** - The PowerPC embedded program broadcasts a BOOTP/DHCP (Boot Strap Protocol / Dynamic Host.
- **IO 1** - A BOOTP/DHCP reply message has been received from an external boot server containing:
  - IP address of the server providing the PowerPC application program
  - name of the file containing the PowerPC application program
  - IP address assigned to the transceiver board
  - subnet-mask to be used for receiving limited broadcast messages.
- **IO 2** - The PowerPC sends a TFTP (Trivial File Transfer Protocol) request to the boot server asking for its application program. The application program has been successfully down-loaded and is up and running.
- **IO 3** - The PowerPC embedded program is up and running. The PowerPC embedded program is included in the FPGA firmware as initialized block RAM.
- **IO 4** - This LED flashes when the receivers are running and generating sample data. The flash speed is proportional to the receiver decimation clock.
- **IO 5** - This LED is reserved for product maintenance tasks at Kongsberg Maritime.

- **IO 6** - This LED flashes every time TXENABLE goes active.
- **IO 7** - The MicroBlaze embedded program is up and running. The MicroBlaze embedded program is included in the FPGA firmware as initialized block RAM.

Switches

The TRX32 board holds two switches, SW1 and SW2.

→ *Switches location - see figure on page 68*

SW1

Board ID upper bits switch. SW1 1 ON require TRX32 rev H and system backplane support for 8 ID bits. The Version Acknowledge reports which method is selected.

SW1 - 1	Rack ID select: P1 A1 - A3 (ID5 - ID7) / SW1 Rack ID bit 0 - 2	ON/ OFF
SW1 - 2	Rack ID bit 0	ON = 0
SW1 - 3	Rack ID bit 1	ON = 0
SW1 - 4	Rack ID bit 2	ON = 0

SW2

The PROM revision select is for future expansion, current PROM only holds one configuration.

SW2 - 1	Firmware configuration PROM revision select mode software / hardware OPEN / CLOSED	OPEN
SW2 - 2	Firmware configuration PROM revision bit 0	OPEN
SW2 - 3	Firmware configuration PROM revision bit 1	OPEN
SW2 - 4	Not connected	

Links

The TRX32 board holds the following links:

→ *Links location - see figure on page 68*

ST1 - ST4	Used for Ethernet field upgrade of FPGA configuration firmware	CLOSED
ST5	No function	OPEN
ST6 HALT	Alternative use of LED's and test points for debugging purpose	OPEN
ST7 TRST	No function	OPEN
ST8	Legacy PPC software control of start FPGA configuration from firmware PROM	CLOSED

ST9 PROG	Manual control of start FPGA configuration from firmware PROM	OPEN
ST10 INIT	Manual reset of the firmware PROM internal address counter	OPEN

Connectors

- **P1** - a 96-pin, male right-angled euro-connector, located on the rear edge of the board. It carries power and digital control signals.
- **P2** - a 96-pin, male, right-angled euro-connector, located on the rear edge of the board. Connector for the transducer elements cables (two wires per element).
- **P3, P4, P5, P7, P8, P9**, male, right-angled connectors, located on the front edge of the board.

Degree of protection:	IP 66

Transmit synchronization with external equipment

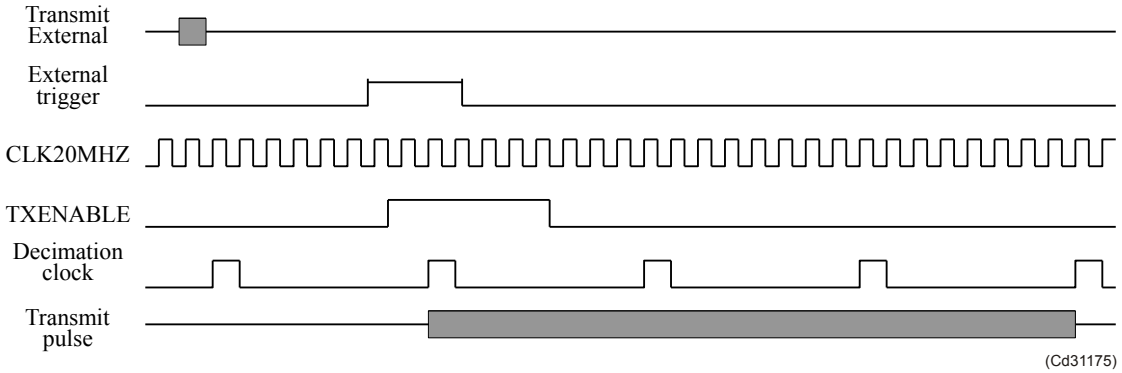


Figure 26 Transmit synchronization with external triggering

In some applications the transmit cycle is triggered by an external hardware signal:

1 The host computer downloads a sequence of Ethernet commands (broadcast or individually addressed) into the transceiver boards containing a high level description of the transmit pulse.

2 The host broadcasts a Transmit External command to the transceiver boards.

3 All boards (master and slaves) toggle their TR-switch (Transmit/Receive-switch) from receive to transmit position when receiving the Transmit External command.

4 The master board generates a TXENABLE pulse when a positive edge on the SYNC_IN signal (front panel connector P4) is detected. The TXENABLE transitions are aligned with the negative edge of CLK20MHZ. The duration of this signal is equal to the duration of the transmitter pulse.

5 All boards (master and slaves) start transmitting on the first receiver decimation tick (positive edge of decimation clock) after TXENABLE has gone high. The positive edge of the decimation clock is aligned with the positive edge of CLK20MHZ. The decimation clock is not available as an external signal.

On the board

The P4 connector can be used for accurate transmit synchronization with external equipment.

The differential output signal **goes high** (+SYNC_OUT = +3.3V, -SYNC_OUT = 0V) when the transceiver board starts transmitting and **goes low** (+SYNC_OUT = 0V, -SYNC_OUT = +3.3V) when the transmit pulse finishes.

The two outputs are short circuit protected. Their output impedance is approximately 30 k. The differential input signal is used for controlling start of transmission of the transceiver board. Transmission is delayed until a pulse arrives at this input when the board operates in external trigger mode, positive edge of the differential voltage (+SYNC_IN) - (-SYNC_IN).

The maximum voltage range of both inputs is -7 V to +12 V. The differential input impedance is >12 k.

Fuses

→ *Fuses location - see figure on page 68*

Removal

1 Remove the TRX32 circuit board.

→ *Refer to page 55*

2 Use a pair of flat nosed pliers, and grab the fuse carefully on each side. Pull it straight up.

The following fuses are used:

- F1/F2 Kongsberg Maritime order no. 251-086584
- F3/F4 Kongsberg Maritime order no. 251-097722

Replacement

Note *The new fuse MUST be the same rating as the old.*
DO NOT replace with a larger rated fuse.

3 Push the fuse straight down into its socket.

4 Replace the TRX32 circuit board.

→ *Refer to page 55*

TRX32 Transceiver board visual inspection

The TRX32 Transceiver board is provided with several front mounted LED indicators. Observe the following procedure to check these.

LED group (A):

Link - Check that this LED flashes green. This means that the communication with the Ethernet switch is operational

Speed - Check that this LED is lit yellow. This means that the communication speed is 100 Mbit/s

Activity - Check that this LED flashes green. This means that the communication is active

Duplex - Check that this LED is lit yellow. This means that the communication is running in full duplex mode.

LED group (B):

Check that all LEDs are lit green. This means that the respective supply voltages are present

The TRX32 Transceiver board is provided with several front mounted LED indicators. Observe the following procedure to check these.

- If a power indicator LED is switched off on only one single TRX32 board, this may be caused by a blown fuse on the board.
- If a power indicator LED is switched off on all the TRX32 boards in the rack, you have a common power problem, and need to check the Power Supply Unit for the relevant rack.
- If one of the communication LEDs (Group A) are suspicious;

- Check the Ethernet cable between the TRX32 board and the Ethernet switch.
- Then, check the Ethernet switch.

Related topics

→ *TRX32 Transceiver board on page 66*

→ *Replacement of the TRX32 Transceiver board on page 55.*

TRX32 filter board

The TRX32 filter board is a special made board containing 32 band pass filters and a capacitor battery.

The board is normally used as a front end module for a TRX32 board.

The board is locked in position by two board ejectors.

Function

Signals coming from the transducer are filtered before they are supplied into the TRX32 board.

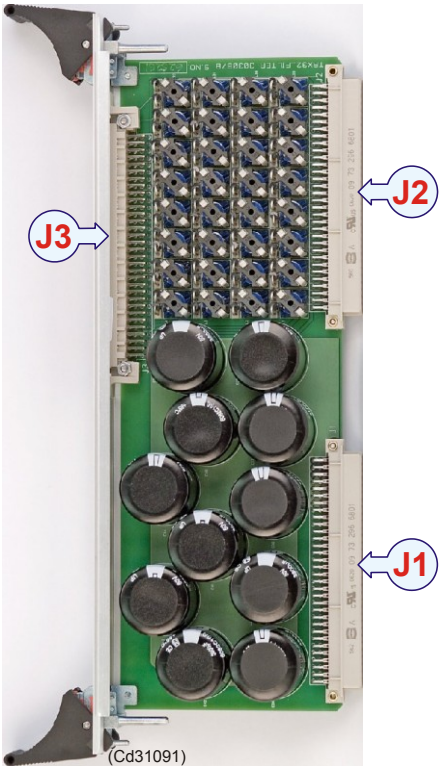
The capacitor battery supplies preloaded energy to the transmitters on a TRX32 board.

In a HiPAP transceiver unit, the TRX32 Filter boards are mounted on the rear side of the TRX32 boards and the backplane. One TRX32 Filter board is connected directly through the backplane to one TRX32 board.

The 32 band pass filters, filters the input signals coming from 32 transducer elements into J3, before the 32 input signals are supplied out to J2. When the TRX32 board transmits into J2, the filters will pass the transmitted pulse directly to the transducer without any filtering out from J3.

The capacitor battery is connected to J1 and is made of 11 capacitors in parallel giving totally 11 X 3900 uF = 42 900 uF.

Connectors



The TRX32 filter board carries three connectors as follows:

- **J1 -** connector for capacitor battery
- **J2 -** connector for filtered signals to the TRX32 board
- **J3** - connector for the transducer elements

9 SPARE PARTS

This chapter lists the parts and modules defined by Kongsberg Maritime as *Line Replaceable Units (LRUs)*. The unit name and order number are given.

Mounting components (such as nuts, bolts, washers etc.) have not been allocated order numbers as we regard these items as standard commercial parts available from retail outlets around the world.

Topics

Operator station

Parts for the Operator station may also be used as spares for the Transceiver APC1x.

Part no.	Item name	Recommended spares
-	**Technical data**	
331890	Acoustic Positioning Computer (APC 12)	1
-	-	-
305096	Power supply unit	-
-	-	-
303326	Hard disk	1
-	-	-
719-099083	DVD-Recorder (ND-3520AA IDE black)	-
-	-	-
304737	Ethernet PCB	-
-	-	-
306143	Serial adapter board	1
-	-	-
304738	Video adapter board	-
-	-	-
649-096720	EMC ground cable	-
-	-	-
599-217736	Dust filter	-
-	-	-
354149	Kensington Trackman mouse	-
-	-	-
719-098786	Keyboard	-
-	-	-
298-099130	Display	-
-	-	-
KIT-216149	1PPS Converter Kit (Option)	-
-	-	-

Retrofit Transceiver unit

HiPAP 501/451/351 system

Part no.	Item name	Recommended spares
-	**Technical data**	
303088	PCB TRX32, 501	1
-	-	-
304337	PCB TRX32 Filter	-
-	-	-
304605	PCB POWER SUPPLY PSU-48V DC	1
-	-	-
318101	DS-518 Ethernet switch	1
-	-	-
382-079671	PCB POWER SUPPLY PSU-MAIN	1
-	-	-
318101	DS-518A Ethernet Switch	-
-	-	-
310181	DR-4524, 45W/2A DIN-Rail 24 VDC Power Supply	1
-	-	-

Transducer cable with plug

Use the transducer cable with plug when replacing the transceiver.

Part no.	Item name
305230	TD plug conversion kit

10 HIPAP MODELS AND POSITIONING PRINCIPLES

The HiPAP systems are designed to provide accurate positions of subsea objects such as Remotely Operated Vehicles (ROVs), autonomous underwater vehicles (AUVs), towed bodies or fixed seabed transponders. To achieve the accuracy, the HiPAP system uses unique signal processing techniques. This technique enables narrow transmitter and receiver beams to be generated in all directions within the lower half of the transducer using electronic beam control.

The HiPAP 501/451/351 systems are the second generation HiPAP systems. These models have a new transceiver unit and a new signal processing algorithms for Cymbal processing.

Cymbal is KM's new acoustic protocol for positioning and communication.

All HiPAP systems; HiPAP 501, HiPAP 451 and HiPAP 351 have common software and hardware platforms, and thereby offer the same kind of additional functionality and options.

- The HiPAP 501, HiPAP 451, HiPAP 351 systems are medium frequency systems operating from 21 kHz to 31 kHz.

Topics

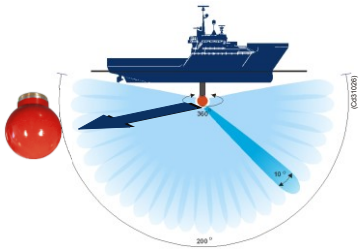
→ *HiPAP 501 System on page 79*

→ *HiPAP 451 System on page 80*

→ *HiPAP 351 System on page 80*

→ *Positioning principles and processing on page 81*

HiPAP 501 System



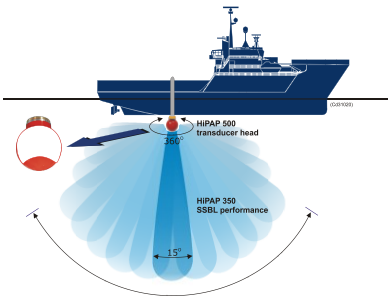
The HiPAP 500 transducer has a full spherical body including 241 transducer elements. This model has close to full accuracy in the half sphere sector and is the preferred system where the best possible performance is required. The HiPAP 501 can also track targets above the half sphere sector.

The use of *very narrow beams* provides:

- High accuracy
- Long range capabilities
- Good noise reduction capabilities
- Good multipath suppression

The HiPAP 500 transducer has a diameter of 392 mm and will be installed with the 500 mm gate valve.

HiPAP 451 System



The HiPAP 450 transducer is the same unit as the HiPAP 500 transducer. The system has Transmitter/Receiver boards for only 46 elements, similar to the HiPAP 351 system.

The HiPAP 451 system has the same operational and technical performance as the HiPAP 351 system.

→ Refer to HiPAP 351 system description on page 80.

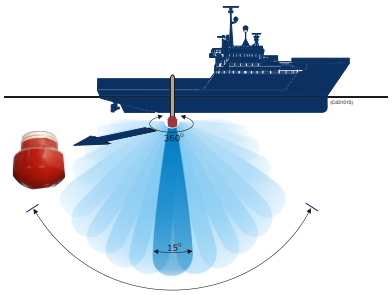
The HiPAP 451 uses the same hull units as the HiPAP 501.

Upgrade to HiPAP 501

The HiPAP 451 System can be upgraded to full HiPAP 501 system performance. This is done by:

- Insert 6 additional Transmitter/Receiver Boards in the transceiver unit which is fully prepared for this.
- APOS software upgrade.

HiPAP 351 System



The HiPAP 350 transducer has a spherical transducer with a cylindrical body including 46 transducer elements. This model has good accuracy in the ± 60° sector and is suited for operations where the major positioning objects are within this sector.

The use of *narrow beams* provides:

- High accuracy
- Long range capabilities
- Good noise reduction capabilities
- Good multipath suppression

The HiPAP 350 transducer has a diameter of 320 mm and it will be installed with a 350 mm gate valve. Installing the system with a 500 mm gate valve, will enable an easy upgrade to a HiPAP 501 system.

Positioning principles and processing

The HiPAP system uses two different principles for positioning; the SSBL and the LBL. These two principles have different properties that make the system flexible for different applications.

- The SSBL principle is based on range and direction measurement to one transponder, while the LBL principle is based on range measurements to minimum three transponders on the seabed.
- The SSBL principle, due to its simple operation, is the obvious choice if the accuracy is good enough for the application performed. The LBL principle is the obvious choice if the SSBL accuracy is not good enough for the application performed, though it requires a more complex operation.
- Cymbal is a signal processing technique used for all positioning modes. Cymbal utilizes Direct Sequence Spread Spectrum (DSSS) signals for positioning and data communication. DSSS is a wide band signal. The Cymbal protocol provides new characteristics for both positioning and data communication.

SSBL positioning

In SSBL, the system calculates a three-dimensional subsea position of a transponder relative to a vessel-mounted transducer. The position calculation is based on range and direction measurements to one transponder. The onboard transducer transmits an interrogation pulse to a subsea transponder, which then answers with a reply pulse. When using a responder the interrogation is replaced by a hard wire trigger connection.

- The onboard system will measure the time from the interrogation to the reply pulse is detected and use the sound velocity to compute the range.
- The transponder position is presented both numerical and graphically on the operator station. Only one onboard SSBL type transducer is necessary to establish this position.

Using a pressure sensor in the subsea transponder can increase position and depth accuracy. The pressure is measured and transmitted to the surface HiPAP system using acoustic telemetry. The depth is then used in the algorithms for establishing the 3D position. The system can also read the depth via a serial line input from a pressure sensor. Simultaneous use of many transponders is made possible by using individual interrogation and reply frequencies.

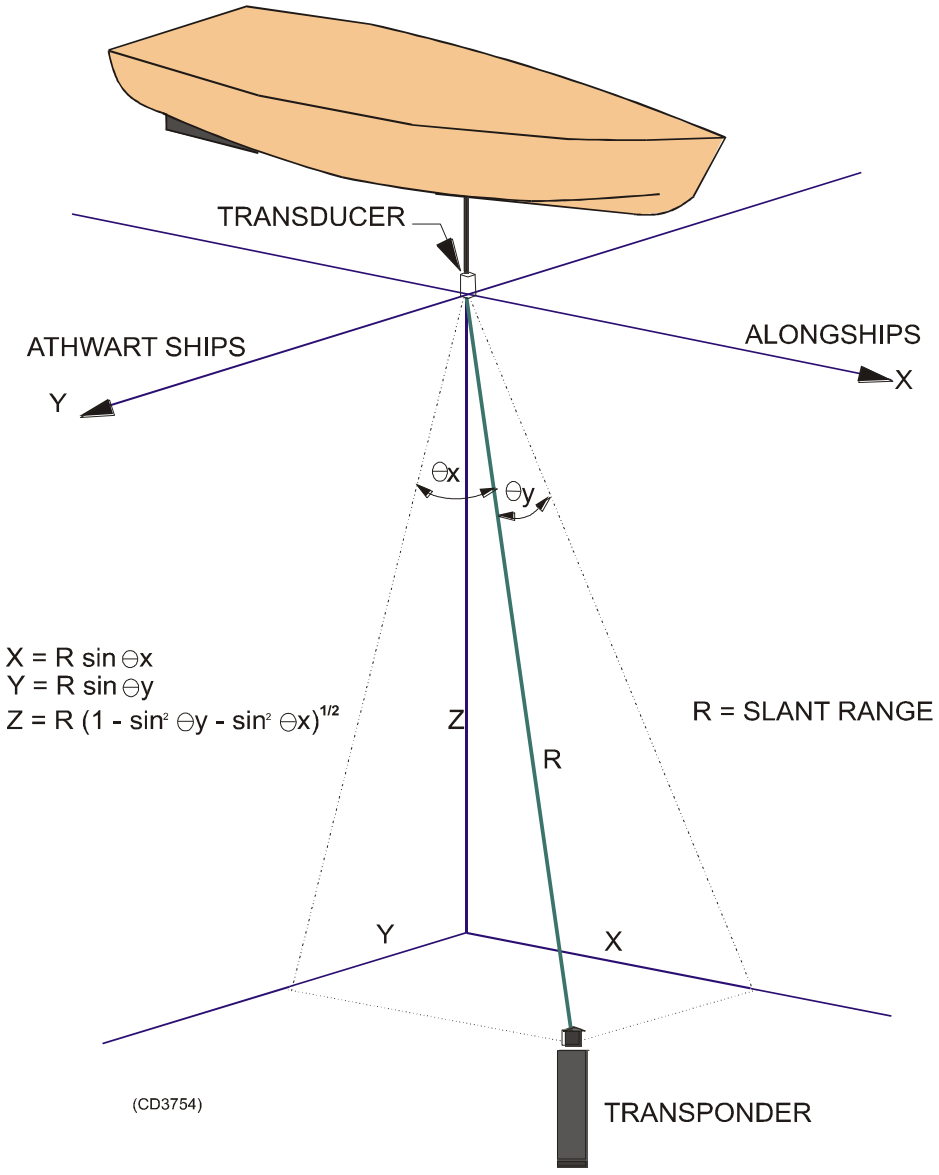


Figure 27 SSBL principle

LBL positioning

Calibration

The LBL principle is based on one vessel-mounted transducer, and normally 4 - 6 transponders on the seabed. This seabed transponder array must be calibrated before LBL positioning operations can begin. The calibration shall determine the transponder's positions in a local geographical co-ordinate frame.

The HiPAP system supports two calibration techniques:

1. Baseline measurements

This technique uses automatic calibration functions in the HiPAP system. This allows all the ranges to be measured and made available by acoustic telemetry communication between the transponders and the vessel's system. Based on the baseline measurements and initial positions of the transponders, the calibrated transponder positions are computed.

2. Runtime calibration

To use this technique, the system is run in LBL positioning mode, using the SSBL positions of the seabed transponders for the vessel LBL position calculation. The runtime calibration function logs the measurements. Based on this, new optimised seabed transponder positions will be computed. This technique makes the baseline measurements redundant. If the baselines measurements are done, they are also used in the calculations.

The calibration is performed only once prior to positioning operation, since the transponders will remain in the same location during the operation.

Positioning

When the transponder positions are known, positioning of the surface vessel can begin. All the seabed transponders will be interrogated simultaneously, and each will respond with its specific reply signal. The LBL system will then calculate the ranges from the individual transponders. By using the calibration data together with the calculated ranges in software algorithms, the vessel or an ROV can be positioned. ROV positioning requires an HPR 400S transceiver to be mounted on the ROV.

- The system can take the depth from an ROV-mounted pressure sensor via a serial line. By using this depth in the computation, it will increase the position accuracy of the ROV.

- The range capabilities of a medium frequency LBL system will be approximately the same as those of an SSBL system.
- LBL positioning will give better position accuracy at greater water depths, but is more complex to operate, and it needs more transponders than the SSBL.
- LBL TP positioning method uses one transponder to measure the ranges to the transponders in the array and telemetry the data to the surface vessel, which computes the position of the transponder.

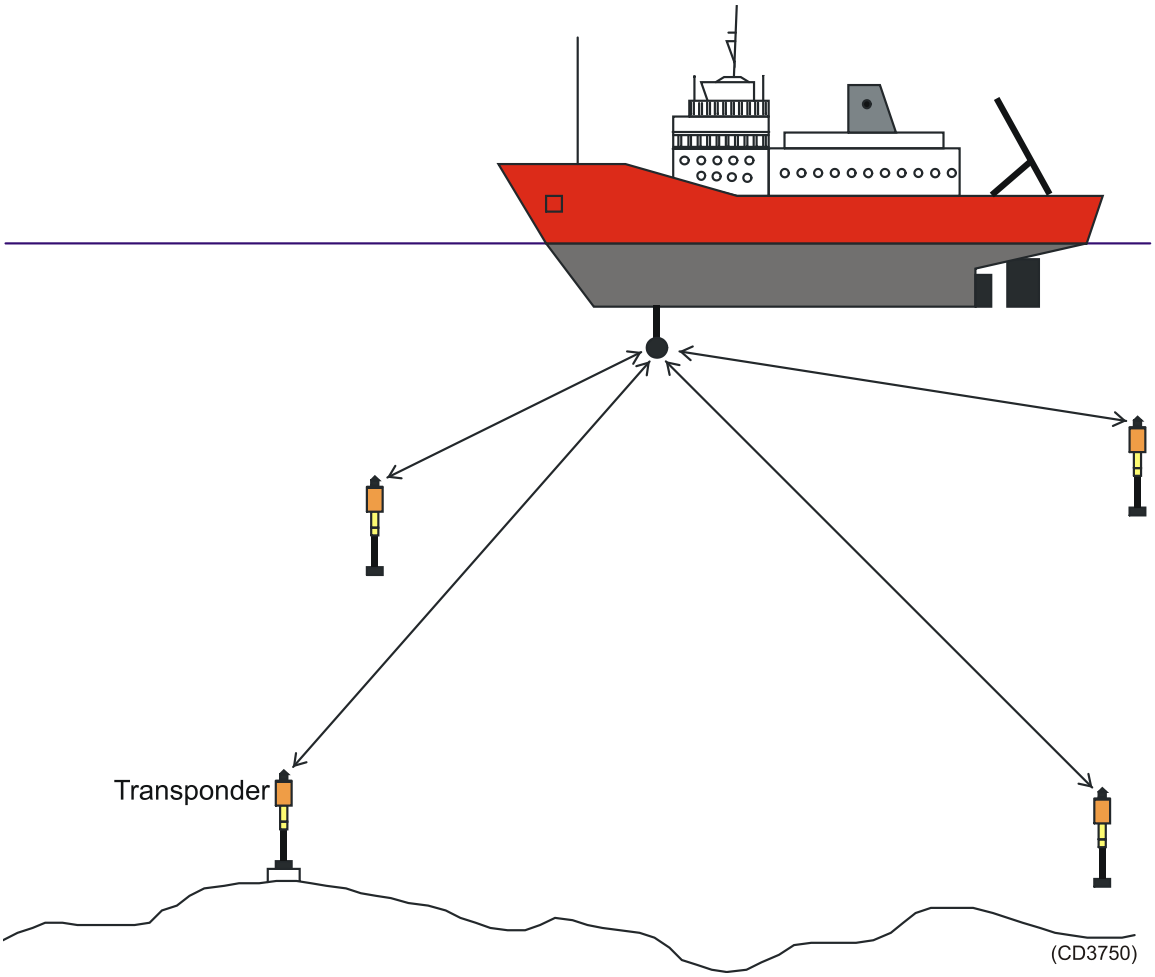


Figure 28 LBL principle

Multi-User LBL positioning

Several individual vessels and ROV units can now position themselves using the same seabed transponder array. The system and principle has the following main advantages:

- Provides high position accuracy (comparable to standard LBL).
- A small number of transponders serve all vessels and ROVs.
- Secures high position update rate (down to approx. 2 seconds), which is essential in DP operations.
- Avoids transponder frequency collisions when vessels are working in the same area (all vessels are “listening” only).

A transponder array is deployed and calibrated by use of subsea baseline measurements. One transponder is used as the Master in the positioning phase. The other transponders are called the Slaves.

The Master transponder acts as a beacon. It starts a positioning sequence by doing the steps described below. This is done regularly with an interval set by telemetry from one of the vessels.

- The Master interrogates the Slaves.
- The Master transmits its individual transponder channel to be received by the vessels/ROVs positioning in the array.
- Each Slave transponder receives the interrogation from the Master and transmits its individual reply channels after a turnaround delay.

A MULBL system positioning in the array listens for the individual channels transmitted by the master beacon, and by the Slave transponders. When they are received, the system uses its knowledge about their positions in the TP array to calculate the differences in range to the transponders in the TP array. The time difference between the Master interrogation and the start of the reception of the pulses at the system is unknown. It has to be calculated together with the position of the vessel or ROV.

All vessels to use the MULBL array need the coordinates of the transponders and the channel numbers, which will be distributed of a file.

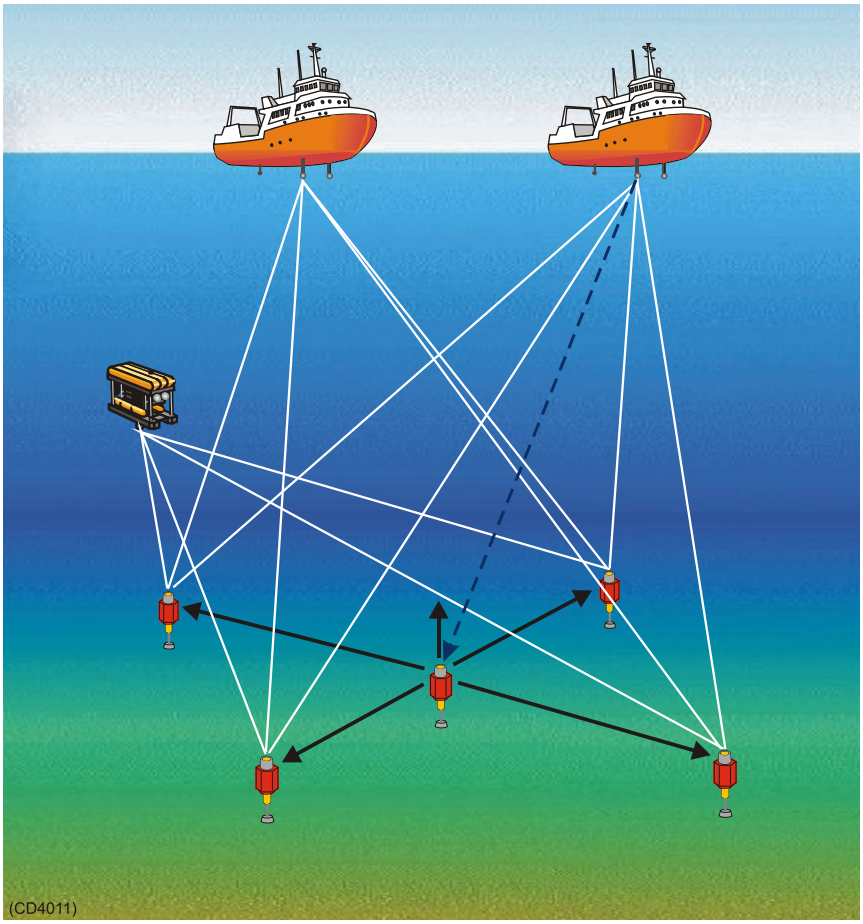


Figure 29 Multi-User LBL positioning

Combined SSBL and LBL positioning

The combined SSBL/LBL system uses an onboard multi-element transducer. The system may operate as an SSBL system and as an LBL system simultaneously.

As an example, the vessel may be positioned relative to the seabed using LBL while an SSBL transponder/responder on an ROV is positioned relative to the vessel. The vessel is displayed relative to the array origin and the ROV relative to the vessel.

The combined system will also use the measured directions in 2D together with the measured ranges in the LBL positioning. The combined measurement gives a robust system with increased accuracy. An LBL solution is achievable when only two transponder replies are detected.

HiPAP processing

HiPAP SSBL processing

- The HiPAP system determines the position of a subsea target (transponder or responder) by controlling a narrow reception beam towards its location. The system uses a digital beam-former, which takes its input from all the transducer elements.
- The system uses a number of wide fixed beams to generate an approximate position for the target. Once this is achieved, it uses data from all the elements on the hemisphere facing the target to compute the narrow reception beam and optimise the directional measurement.
- The range is measured by noting the time delay between interrogation and reception. The system will control the beam dynamically so it is always pointing towards the target. The target may be moving, and the vessel itself is affected by pitch, roll and yaw. Data from a roll/pitch sensor is used to stabilise the beam for roll and pitch, while directional data from a compass is input to the tracking algorithm to direct the beam in the correct horizontal direction.
- The HiPAP® transceiver can operate with up to 56 transponders simultaneously. The data is sent to the APC 1x.

HiPAP LBL processing

- This mode is similar to the HiPAP® SSBL processing, but the transceiver positions up to 8 LBL transponders for each single LBL interrogation. Both ranges and directions to the transponders are measured.

HiPAP MULBL processing

- This mode is similar to the HiPAP® LBL processing, but the transceiver does not interrogate the MULBL transponder array, it only listen for the replies from the array. The transceiver can listen for to 8 LBL transponders. The direction to the transponders and the time difference between the received replies is transmitted to the APC 1x.

HiPAP Telemetry processing

- The unit transmits acoustic telemetry messages, and receives and decodes the acoustic telemetry message from the transponder. The data is sent to the APC 1x.

Cymbal acoustic protocol

Cymbal is the new acoustic protocol used for both positioning of subsea transponder in SSBL/LBL mode and data communication to and from transponders.

The technology

Cymbal utilizes Direct Sequence Spread Spectrum (DSSS) signals for positioning and data communication. The data communication speed is variable and can be adapted to the acoustic communication conditions; noise and multi-path.

DSSS is a wide band signal.

The Cymbal protocol provides new characteristics for both positioning and data communication.

Range capability and reduced impact from noise

Cymbal protocol can transmit more energy in each positioning pulse. Compared to the current HiPAP 500 this extra energy will provide higher position accuracy at low signal to noise ratio. It will also provide longer range capabilities. This improvement in energy is 5dB.

Range accuracy

The Cymbal signal gives range accuracy in the order of 0.01m, error contribution from sound velocity and ray bending not included.

Directional measurements

In SSBL operation, the accuracy of directional measurement is the main contributor to the position accuracy. The HiPAP 501 has new and improved algorithms for directional computation when using Cymbal. At low signal to noise ratio the system will be more robust.

Number of channels

The Cymbal protocol has increased number of unique codes for transponder channels compared to the current system. At present there are 50 unique transponder channels.

Multi-path capability

The Cymbal protocol is designed to have good multi path properties. The processing technique allows signals to and from the transponder to overlap and still be able to have a correct detection.

Position update rate – MultiPing

New function that allows higher position updates rate in SSBL mode. Details not defined.

Power management – lifetime

The Cymbal protocol has a power management function that can command the transponder to adjust transmit power to save batteries. This is done automatically by the system.

Data Link with variable data rate – adaptable

The Cymbal protocol supports variable data rate and high reliability level. The obtainable data rate is defined by the signal to noise level and multi-path conditions. By default the system uses data rates that will secure long range and high reliable communication.

Integrated navigation and data link

Data that needs to be sent to and from a transponder will be interleaved between the positioning signals. The cNODE transponder can any time send status and data to the HiPAP and visa versa. If the cNODE transponder detects low battery level, this can be directly sent to HiPAP and displayed to the operator

cNODE - Modeless transponder

The Cymbal protocol is able to use transponders in SSBL and LBL mode without changing the mode of the transponder. A transponder in an LBL array can by the operator be deselected from the LBL positioning and directly be used in SSBL mode. No data telemetry is required.

The cNODE transponders can simultaneously listen for a Cymbal and an HPR400 channel interrogation. With this function, vessels not having Cymbal protocol can use the same transponders.

11 RESPONDER OPTION

This chapter describes the Responder option for HiPAP systems.

Topics

Basic responder information

The responder option provides drive signals to responders from the HiPAP system. For this function a Responder Driver Unit (RDU) is used. The software is included in the APOS.

- The Responder Driver Unit is controlled from the operator station through the Ethernet connection to the Moxa box in the Transceiver cabinet, selecting the output to be activated. A sync signal from the transceiver controls the timing of the output drive signal.
- The Responder Driver Unit has:
  - **4 individual electrical outputs** - the electrical outputs can be connected directly to a Responder.
    and
  - **4 individual fibre optic outputs** - the fibre-optic outputs have to be converted to an electrical pulse before connected to a Responder. We have a special kit for this purpose.

→ *Kit: part no: 330965 – drawing on page 101*

The outputs can be used when you transmit the Responder drive signals as fibre-optic signals in an umbilical, and convert the signal to an electrical signal in front of the Responder. This gives a good insulation of the driver signal from other voltages in an umbilical.

Responder Driver Unit

The Responder Driver Unit is a stand-alone unit. The unit is protected against dust and water.

Figure 30 Responder Driver Unit

Inputs to the unit:

- Power
- Ethernet
- Sync signal

Outputs of the unit:

- Four electrical responder drive signals
- Four fibre optic responder drive signals

POWER

The RDU unit is powered from an 85 - 264 Vac supply. The power switch is located back at the right side of the unit.

Technical specifications

Responder Driver Unit kit

Part no.:	317925

Includes:

- RDU unit
- Power cable
- Patch cable
- D-sub connectors
- Mounting screws w/nuts (4)

Responder Driver Unit

Weight:	2.8 kg
Degree of protection:	IP 44

→ *Outline dimensions - see drawing on page 97*

Power

Power:	230 Vac, 150 mA
Frequency:	40 - 440 Hz
Inrush max:	5 A Ac
Maximum current drawn:	0.4 A
Normal current drawn:	0.06 A
Nominal power consumption:	15 W/VA

Environmental conditions

Operating temperature:	0 °C to 55 °C
Storage temperature:	-30 °C to 70 °C
Humidity:	15% - 95% (non condensing)

Vibration

Range:	5-100 Hz
Excitation level:	5-13.2 Hz ±1.5 mm, 13.2-100 Hz 1 g

Fibre to responder drive converter kit

Part no.:	330965

→ *Drawing on page 101*

Installation

Responder Driver Unit

The Responder Driver Unit is a stand-alone unit and can be mounted with 4 off screws horizontally or vertically.

Unit location

The unit should be located where it is most suitable for connecting the cables to the responders. This can be close to Remote Operating Vehicle (ROV) operation room.

There is normally one cable connected to the Responder Driver Unit for **each responder** to be operated. The unit must be installed so it is easy accessible for operators to check the working condition of the responder trig status diodes.

Logistics

Safety - Refer to the general safety procedures.

Special tools - None.

Drawings - Outline dimensions - see drawing on page 97

Mounting

1 Open the unit.
- Remove the four (4) screws which secure the lid (one in each corner).

2 Lift off the lid.
- There are four (4) through holes for the mounting screws inside the unit (one in each corner).

3 The mounting screws w/nuts are a part of the RDU kit (delivered with the unit).

→ *RDU kit on page 92*

4 Mount the RDU where suitable.

5 Fasten the four (4) mounting screws.

6 Close the unit.

Maintenance

Note — *Before you start, read the general maintenance information on page 43.*

Responder Driver Unit

Under normal conditions, maintenance is not required, apart from keeping the unit clean. If the unit is not functioning properly, the unit must be replaced.

The unit is interfaced to the HiPAP system via an Ethernet connection and hard wired to the HiPAP transceiver unit to get the sync pulse for correct timing. The APOS controls which drive is being active while the sync is received from the HiPAP Transceiver. The unit itself must be switched on prior to use. Power to the unit is 230 Vac.

Figure 31 Responder Driver Unit

Connections

Caution — *When not mounted/used - keep the protecting caps on the fibre-optic connectors.*

Four electrical outputs (**C**) and four fibre optical outputs (**B**) are available. Totally 8 outputs can be used. There is a green LED indicator for every responder drive output (**A**) showing the activity on the output. There is also a power on LED indicating power is on (**D**).

- The 4 electrical outputs can separately be connected directly to separately responders. Output drive signal to responders is a +24V electrical pulse of 4.5 ms or a fibre-optic pulse.

- The 4 optical outputs are normally connected with a fibre-optic cable to 4 separately converters with their own separate power. One converter for every responder. The fibre-optic output pulse is 4.5 ms as the electrical pulse.

→ *Fibre to responder drive converter on page 92*

- The converter power is normally the same power as the responder is powered from.
- The converter converts the optical signal back to an electrical signal before supplied to a responder.
  - Converter to be used: 326494 is a part of kit 330965
  - Fibre optic patch cable that can be used: 719-097260 FC-2/2-2M.

→ *Responder Driver Unit replacement, see installation on page 93*

Fibre to responder drive converter

Figure 32 Illustrating a system using two optic responder converter kit - electrical connection to the responder is not shown

A: *Fibre-optic connector*
B: *Power supply cable (Local power cable is shown here)*
C: *Electrical connector*
D: *Fibre-optic patch cables*

→ *Kit see page 92*

Connector type ST

Figure 33 Connector type ST

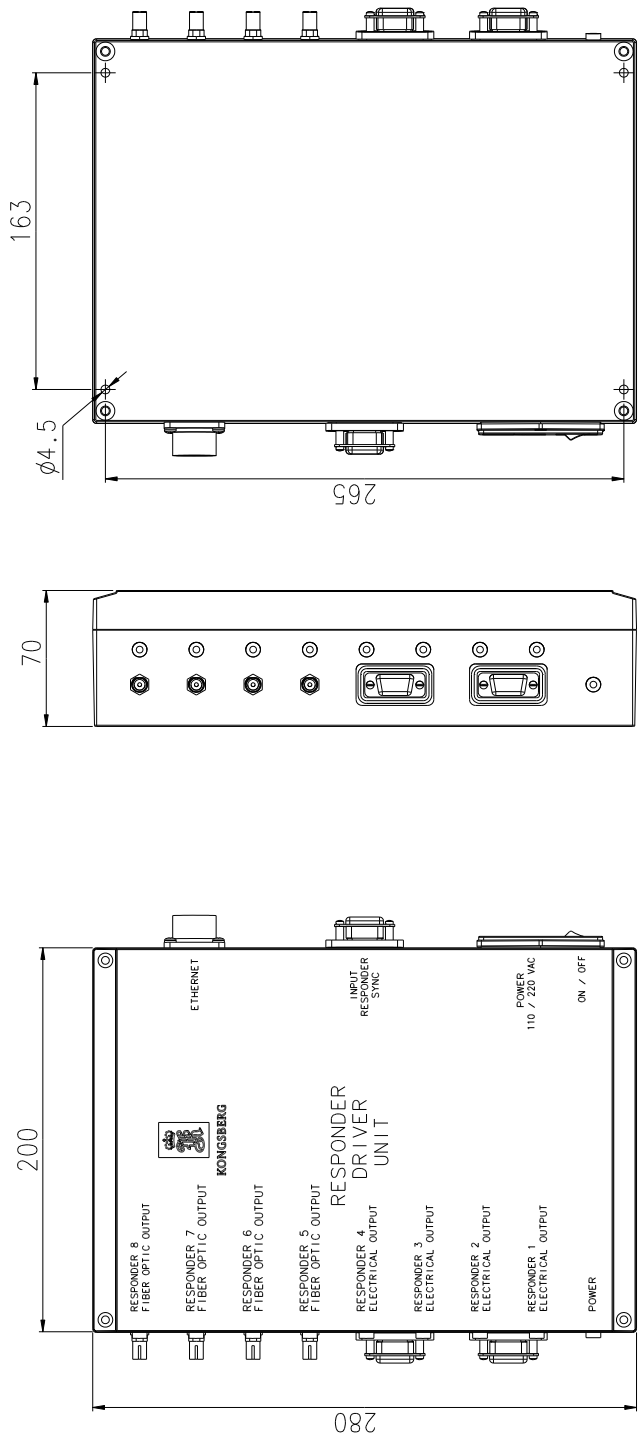
Spare parts

- **Responder Driver Unit**: 319173
- **Power 24 Vdc, 25 mA**: 336494
- **Responder Driver Unit, kit**: 317925
- **Fibre to responder drive converter, kit:** 330965 - drawing on page 101

Drawings

Part No.	Rev.	Description	Ref.
316067	A	Responder Driver Unit (option) - outline dimensions	on page 97
W250A	-	Responder Driver Unit - Pinout responder sync.	on page 98
W251A	-	Responder Driver Unit - Electrical drive signal Responder 1-4 pinout	on page 98
W249B	-	Pinout Responder sync, Responder Driver Unit for Model Retrofit	on page 99
313697	E	Responder Driver Unit - wiring diagram	on page 100
330965	A	Fibre to responder drive converter - wiring diagram	on page 101

Responder Driver Unit - outline dimension



Note:
All measurements are in mm.
The drawing is not in scale.

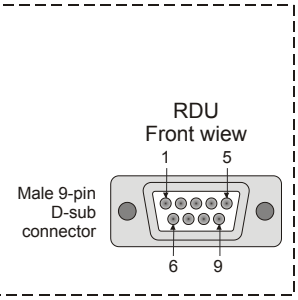
Cd31148 Page 1 of 1
316067 Rev.A

Responder Driver Unit

→ *Refer to Responder Driver Unit - wiring diagram on page 100*

Pinout responder sync.

Responder	9p D-sub
+Sync	1
-Sync	2



W250 Rev.A	Pinout Responder sync for Responder Drive Unit

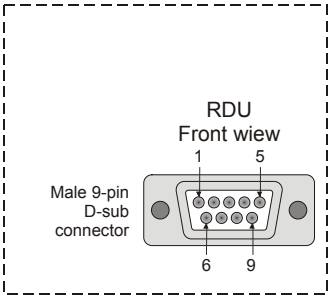
Electrical drive signal Responder 1-4 pinout

Responder 1	9p D-sub
Power 1 +24V	1
Drive signal 1	2
Ground	3

Responder 2	9p D-sub
Power 2 +24V	6
Drive signal 2	7
Ground	8

Responder 3	9p D-sub
Power 3 +24V	1
Drive signal 1	2
Ground	3

Responder 4	9p D-sub
Power 4 +24V	6
Drive signal 2	7
Ground	8



W251 Rev.A	Pinout Responder drive signal 1 to 4 for Responder Drive Unit

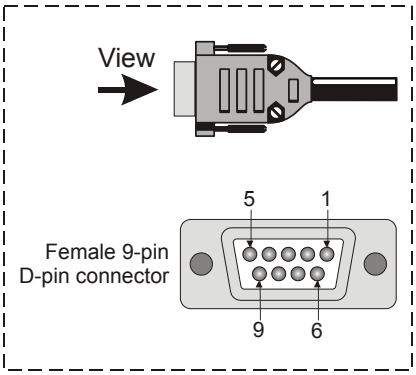
Optical drive signal responder 5-8:

Connector: Industry standard ST fibre connector 850 nm, optical drive signal pulse 5 ms.

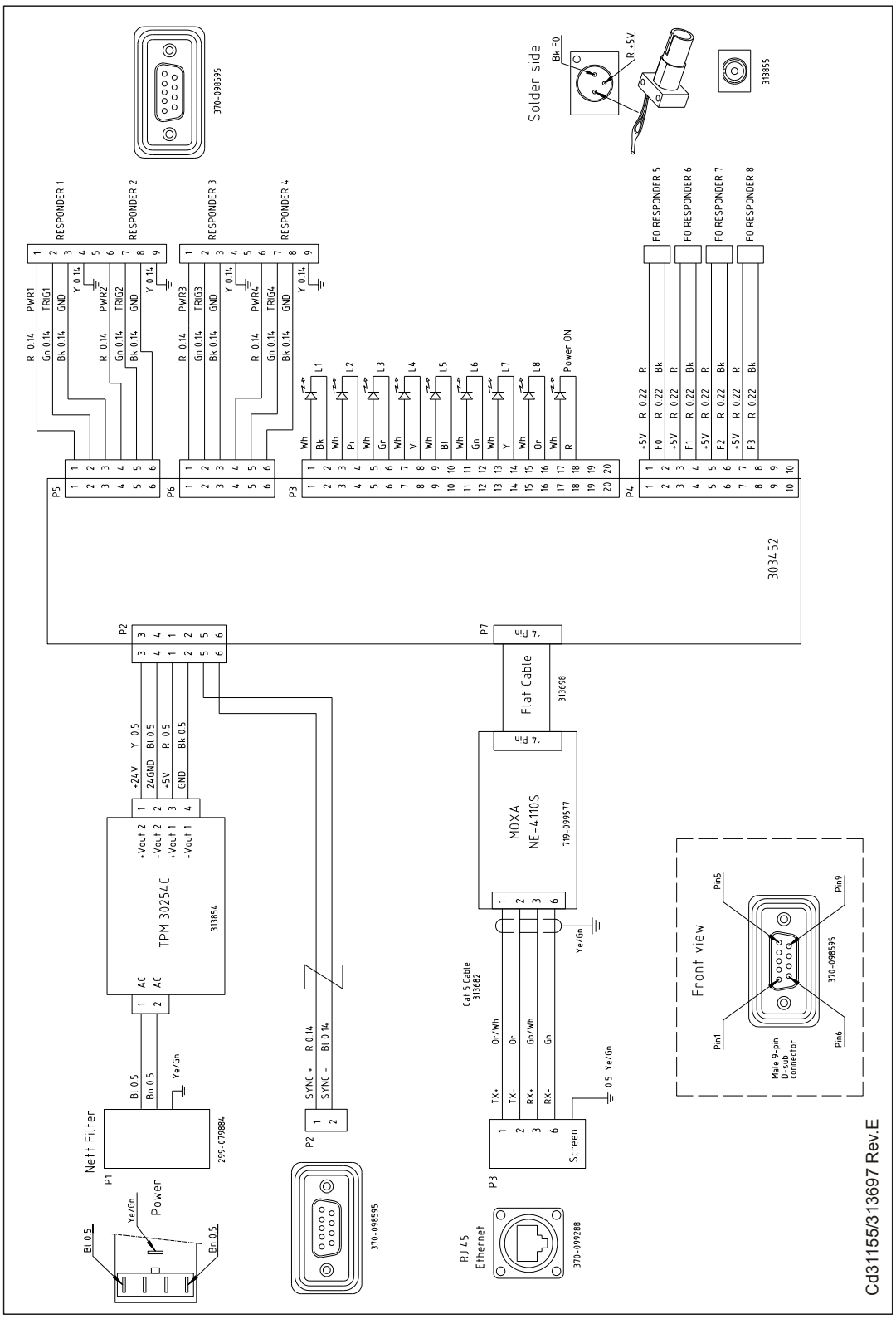
→ *Connector on page 96*

Responder sync cable, Retrofit Transceiver unit

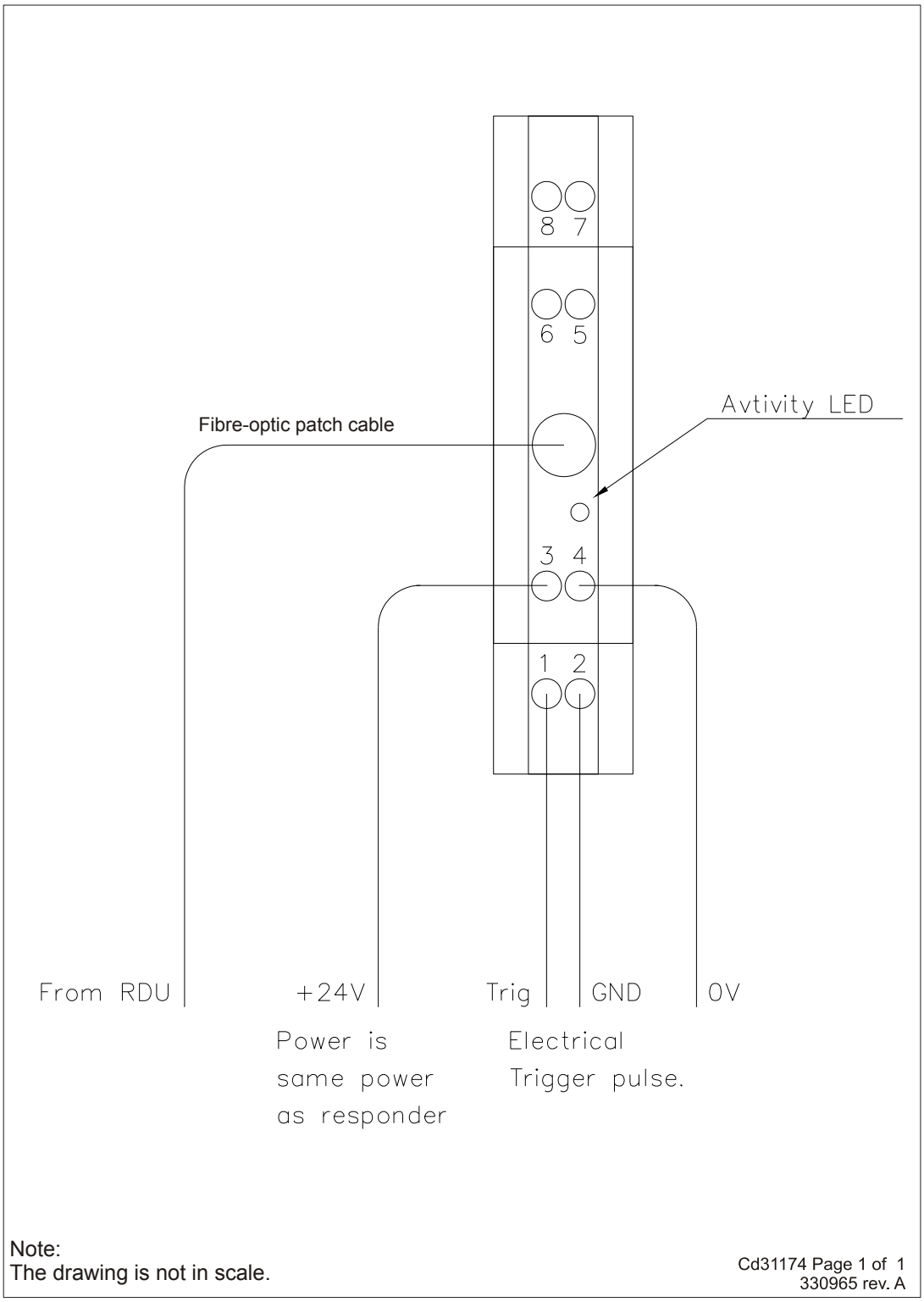
Responder	Terminal block	9p Dsub
+Sync out	12	1
-Sync out	13	2
Ground	14	



Responder Driver Unit - wiring diagram



Fibre to responder drive converter - wiring diagram



Note:
The drawing is not in scale.

Cd31174 Page 1 of 1
330965 rev. A

12 EQUIPMENT HANDLING

This chapter describes how to transport, pack and unpack, clean, preserve and store electronic, electro-mechanical and mechanical units supplied by Kongsberg Maritime.

The units may be supplied as spare parts, or as parts of a delivery.

Topics

Transportation

Unless otherwise stated in the accompanying documentation, electronic, electro-mechanical and mechanical units supplied by Kongsberg Maritime can be transported using all methods approved for delicate equipment; (by road, rail, air or sea). The units are to be transported in accordance with general or specific instructions for the appropriate unit(s), using pallets, transport cases, or carton boxes as appropriate.

Note

Special local restrictions concerning air transportation may be applied to units containing certain types of batteries. The units should be checked and the regulations investigated by the packer/shipper before the unit is dispatched.

Local transportation

All local transportation must be carried out according to the same specifications as for the initial delivery. In general, all units must be handled with care. The carton/case containing the equipment must be kept dry at all times, and must be sheltered from the weather. It must not be subjected to shocks, excessive vibration or other rough handling.

The carton /case will normally be marked with text or symbols, indicating which way it is to be placed. You must follow the instructions given, and ensure that the carton /case is always placed with its “top” uppermost.

The carton/case must not be used for any purpose for which it was not intended (step, table, etc.), and in the absence of other information, no other cartons/cases must be stacked on top of it.

Lifting

A heavy crate will normally be marked with its weight, and the weights of other cartons or crates will normally be entered on the packing list.

- You must always check the weight of a crate before attempting to lift it.
- You must always use lifting apparatus that is certified for the load.

Heavy units may be equipped with lifting lugs for transportation by crane within the workshop or installation area. Before a crane is used, check:

- You must check the applicable weight certificate for the crane.
- You must check the security of the lifting lugs.

Ensure that all available lifting lugs are used. Ensure the unit remains under control during the operation to avoid damage to the unit, equipment or personnel.

Heavy units may be transported using a fork-lift truck. Special attention must then be paid to the position of the unit's centre of gravity. The units must be properly secured to the truck.

Storage prior to installation or use

When a system, a unit or a spare part has been delivered to the customer, it may be subject to long-time storage prior to installation and use. During this storage period, certain specifications must be met. The equipment must be preserved and stored in such a way that it does not constitute any danger to health, environment or personal injury.

1 The equipment must be stored in its original transportation crate.

2 Ensure that the units are clearly separated in the shelves and that each unit is easily identifiable.

3 The crate must not be used for any purpose for which it was not intended (e.g. work platform etc.).

4 The crates must not be placed on top of each other, unless specific markings permit this.

5 The crates must not be placed directly on a dirt-floor.

6 Do not open the crate for inspection unless special circumstances permit so.

- "Special circumstances" may be suspected damage to the crate and its content, or inspections by civil authorities.
- If any units are damaged, prepare an inspection report stating the condition of the unit and actions taken. Describe the damage and collect photographic evidence if possible. Re-preserve the equipment.
- If the units are not damaged, check the humidity absorbing material. If required, dry or replace the bags, then repack the unit(s) according to the packing instructions.

7 If the crate has been opened, make sure that is it closed and sealed after the inspection.

- Use the original packing material as far as possible.

→ *Refer to information on page 109.*

Ambient temperature and humidity

1 The storage room/area must be dry, with a non-condensing atmosphere. It must be free from corrosive agents.

2 The storage area's mean temperature must not be lower than -30° C, and not warmer than +70 °C.

- If other limitations apply, the crates will be marked accordingly.

Note

Transducers must not be stored in temperatures below -30 °C, or higher than +55 °C.

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3 The crate must not be exposed to moisture from fluid leakages.

4 The crate must not be exposed to direct sunlight or excessive warmth from heaters.

Shock and vibration

1 The crate must not be subjected to excessive shock and vibration.

ESD precautions

→ *Refer to the information on page 109.*

Batteries

If the unit contains normal batteries, these may have been disconnected/isolated before the unit was packed. These must only be reconnected before the installation starts. Units containing batteries are marked.

Caution *Units containing lithium or alkaline batteries must be handled separately and with care. Such units are marked accordingly. Do not attempt to recharge such batteries, open them or dispose of them by incineration. Refer to the applicable product data sheets.*

Inspection

An inspection must be carried out immediately after the unit(s) has arrived at their destination.

- Check all wooden or cardboard boxes, plastic bags and pallets for physical damage. Look for signs of dropping, immersion in water or other mishandling.
- If damage is detected externally, you will have to open the packaging to check the contents.
  - Request a representative of the carrier to be present while the carton is opened, so any transportation damage can be identified.
- If any units are damaged, prepare an inspection report stating the condition of the unit and actions taken. Describe the damage and collect photographic evidence if possible. Send the inspection report to Kongsberg Maritime as soon as possible.
- If the units are not damaged, check the humidity absorbing material. If required, dry or replace the bags, then repack the unit(s) according to the packing instructions.

Unpacking

Normal precautions for the handling, transportation and storage of fragile electronic equipment must be undertaken.

Note

If the unit is not to be prepared for immediate use, you may consider storing it unopened in its original packing material. However, it may be useful to open the case to check its contents for damage and retrieve any accompanying documentation.

- Check the carton before opening it to ensure it shows no signs of dropping, immersion in water or other mishandling.
  - If the carton shows signs of such damage, refer to the paragraph covering Inspection on receipt.
- Place the carton on a stable work bench or on the floor with the top of the carton uppermost.
- In the absence of other instructions, always open the top of the carton first. The contents will normally have been lowered into the carton from above, so this will usually be the easiest route to follow.
  - Care must be used when opening the carton to ensure the contents are not damaged.

Caution

Do not use a knife to open cardboard cartons - the contents may lie close to the surface, and may be damaged by the blade.

- If the carton has been closed using staples, remove the staples from the carton as you open it. This will reduce the possibilities of scratch injury to yourself and damage to the contents.
- If a wooden crate has been closed using screws, always remove them using a screw-driver. Do not attempt to prise the lid off with a crow-bar or similar.
- Once the carton is open, carefully remove all loose packaging and insulation material. Check for manuals and other documents that may have been added to the carton during packing, and put these to one side. Check also for special tools, door keys etc.

Electronic and electro-mechanical units

Caution — *Beware of the dangers of Electro-Static Discharge (ESD) both to yourself and to the equipment, when handling electronic units and components. Refer to the ESD precautions starting on page 109.*

Electronic and electro-mechanical units will normally be wrapped in a clear plastic bag. Lift the unit, in its bag, out of the carton and place it in a stable position on the floor/work bench.

Inspect the unit for damage before opening the plastic bag.

Note — *Cables must **never** be used as carrying handles or lifting points.*

Note — *Do not break the seal to open a circuit board package before the board is to be used. If the board package is returned to the manufacturers with the seal broken, the contents will be assumed to have been used and the customer will be billed accordingly.*

Assuming all is well, open the bag and remove the unit.

Open the unit and check inside. Remove any packing and desiccant material that may be inside.

Mechanical units

Mechanical units may be heavy. Using a suitably certified lifting apparatus, lift the unit out of the crate and place it in a stable position on the floor/work bench.

Inspect the unit for damage and remove any packing material that may be inside the unit.

Re-packing

If the unit is not to be installed immediately, re-pack it in its original packing material to prevent damage in the intervening period.

→ *Refer to the information on page 109.*

Storage after unpacking

The unit must whenever possible be stored in its original transportation crate until ready for installation. The crate must not be used for any purpose for which it was not intended (e.g. work platform etc.).

Once unpacked, the equipment must be kept in a dry, non condensing atmosphere, free from corrosive agents and isolated from sources of vibration.

Note

Do not break the seal to open a circuit board package before the board is to be used. If the board package is returned to the manufacturers with the seal broken, the contents will be assumed to have been used and the customer will be billed accordingly.

The unit must be installed in its intended operating position as soon as possible after unpacking.

If the unit contains normal batteries, these may have been disconnected/isolated before the unit was packed. These must then be reconnected during the installation procedure. Units containing batteries are marked.

Caution

Units containing lithium or alkaline batteries must be handled separately and with care. Such units are marked accordingly. Do not attempt to recharge such batteries, open them or dispose of them by incineration. Refer to the applicable product data sheets.

After use storage

If a unit is removed from its operating location and placed into storage, it must be properly cleaned and prepared before packing.

Cleaning cabinets

If a cabinet has been exposed to salt atmosphere while it was in use, it must be thoroughly cleaned both internally and externally to prevent corrosion.

- Wipe the cabinet externally using a damp cloth and a little detergent. Do not use excessive amounts of water as the unit may not be water tight. On completion, dry the unit thoroughly.
- All surfaces must be inspected for signs of corrosion such as flaking/bubbling paint, stains etc. Damaged or suspect areas must be cleaned, prepared and preserved using the correct preservation mediums for the unit. The mediums to be used will usually be defined in the units' maintenance manual.

- Open the unit, and using a vacuum cleaner, remove all dust etc. from the unit. Great care must be taken to ensure the circuit boards and modules are not damaged in the process.

Cables

Wipe clean all exposed cables, and check for damage. If a cable shows signs of wear or ageing, contact Kongsberg Maritime for advice.

Dehumidifier

Place a suitably sized bag of desiccant material (silica gel or similar) into the unit to keep the electronic components as dry as possible.

Coatings

Spray the unit externally with a corrosion inhibitor (e.g. a light oil) before packing.

Re-packing

The unit should be stored and transported in its original packing material and/or crate. In the event that this material is not available, proceed as follows:

- Small units must be protected from damp by being placed within a plastic bag at least 0.15 mm thick. An appropriate quantity of desiccant material should be placed inside this bag, and the bag sealed. The sealed unit must then be placed in an appropriate carton or crate, and supported in the container by appropriate shock-absorbing insulation (polystyrene foam chips etc.).
- Large units must be placed in a suitable cardboard box or wooden crate. The unit must be protected against physical damage by means of shock-absorbing insulation mats. The box must be clearly marked with its contents, and must be stored in a dry and dust-free area.

ESD precautions

What is ESD?

Electro-Static Discharge (ESD) is the transfer of an electrostatic charge between two bodies at different electrostatic potentials, caused either by direct contact or induction by an electrostatic field.

The passing of a charge through an electronic device can cause localised overheating, and it can also “puncture” insulating layers within the structure of the device. This may deposit a conductive residue of the vaporised metal on the device, and thus create a short circuit. This may result in a catastrophic failure, or degraded performance of the device.

ESD Protection during transport and storage

Sensitive electronic equipment must be transported and stored in protective packing bags, boxes and cabinets. The circuit boards must not be transported or stored close to strong electrostatic, electro-magnetic or radioactive fields.

If it is necessary to open and touch the circuit board inside the protective bag, then the following precautions must be taken:

- The working area must be covered by an approved conductive service mat that has a resistance of between 50 kW and 2 MW, and is connected directly to a reliable earth point via its earthling cord
- The service personnel involved must wear a wrist-band in direct contact with the skin, connected to the service mat.
- Printed circuit boards and other components should be placed on the conductive service mat during installation, maintenance etc.

Caution — *If, for any reason, it is necessary to move the circuit board or components from the conductive service mat, they must be placed in an approved anti-static transportation container (e.g. static shielding bag) before transportation.*

- During installation and servicing, all electrical equipment (soldering irons, test equipment etc.) must be grounded.

Temperature protection

If the unit must be protected against extremes of temperature, the carton/crate must be lined on all walls, base and lid with 5 cm thick polyurethane or polystyrene foam.

These units will be identified as delicate in the applicable documentation.

The package must then be clearly marked:

Caution — *Must not be transported or stored in temperatures below -5 degrees Celsius.*

Other units can normally be stored in temperatures between -30 °C and +70 °C, refer to the system's technical specifications for details.

Transducers must not be stored in temperatures below -20 °C and above +60 °C.

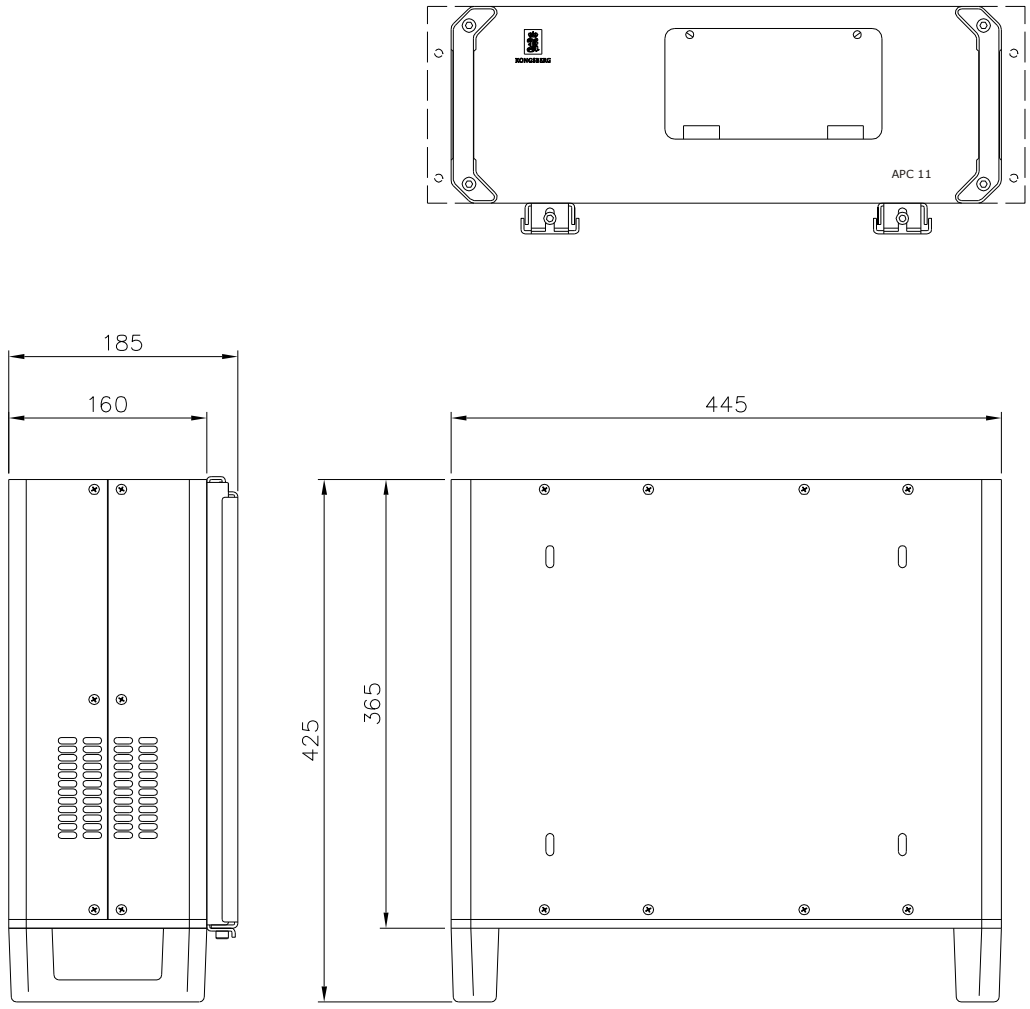
13 DRAWING FILE

This chapter holds illustrations referred to in this manual. The illustrations are based on the original system drawings and wiring diagrams.

- Unless otherwise noted, all measurements are in millimetres.
- The illustrations are not in scale.
- The original drawings are available in electronic format upon request.

Drawings

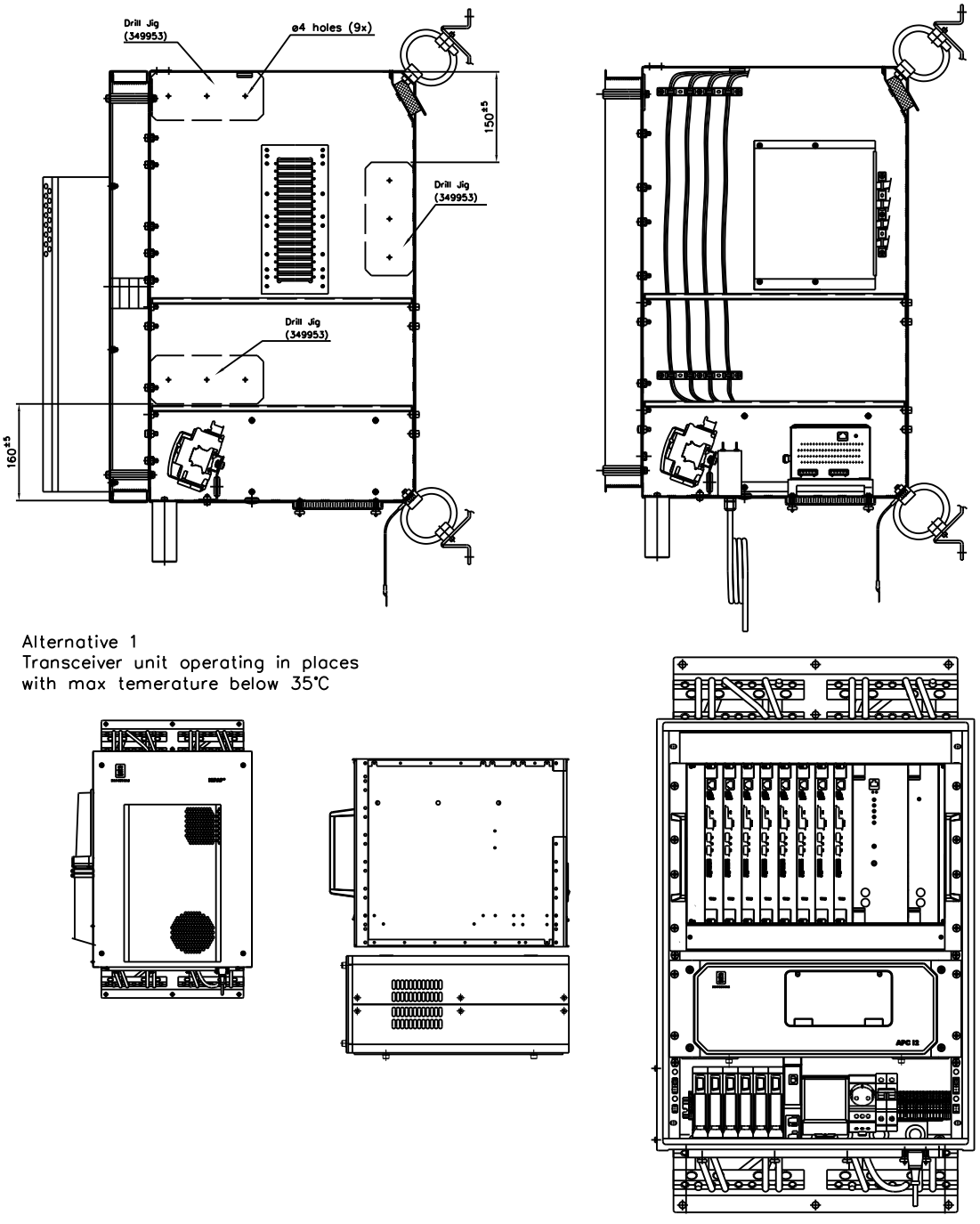
APC 1x - outline dimensions



Note:
All measurements are in mm.
The drawing is not in scale.

Cd31082x Page 1 of 1
210400 Rev.B

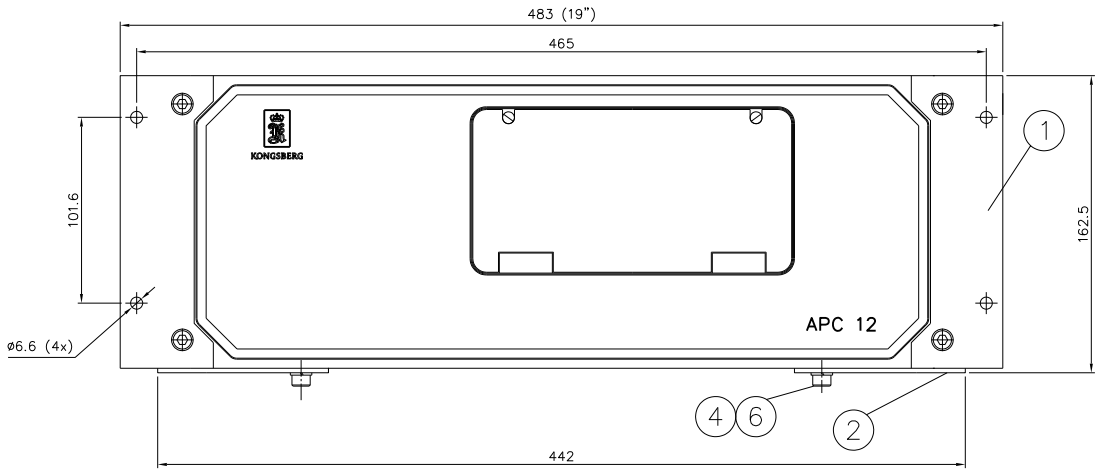
HiPAP 501 Retrofit

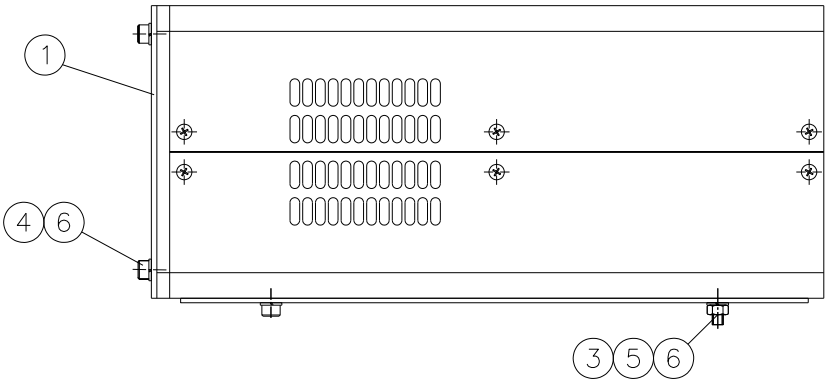


Note:
The drawing is not in scale.

Cd31230 Page 1
348179 Rev. A

Rack Mounting Installation



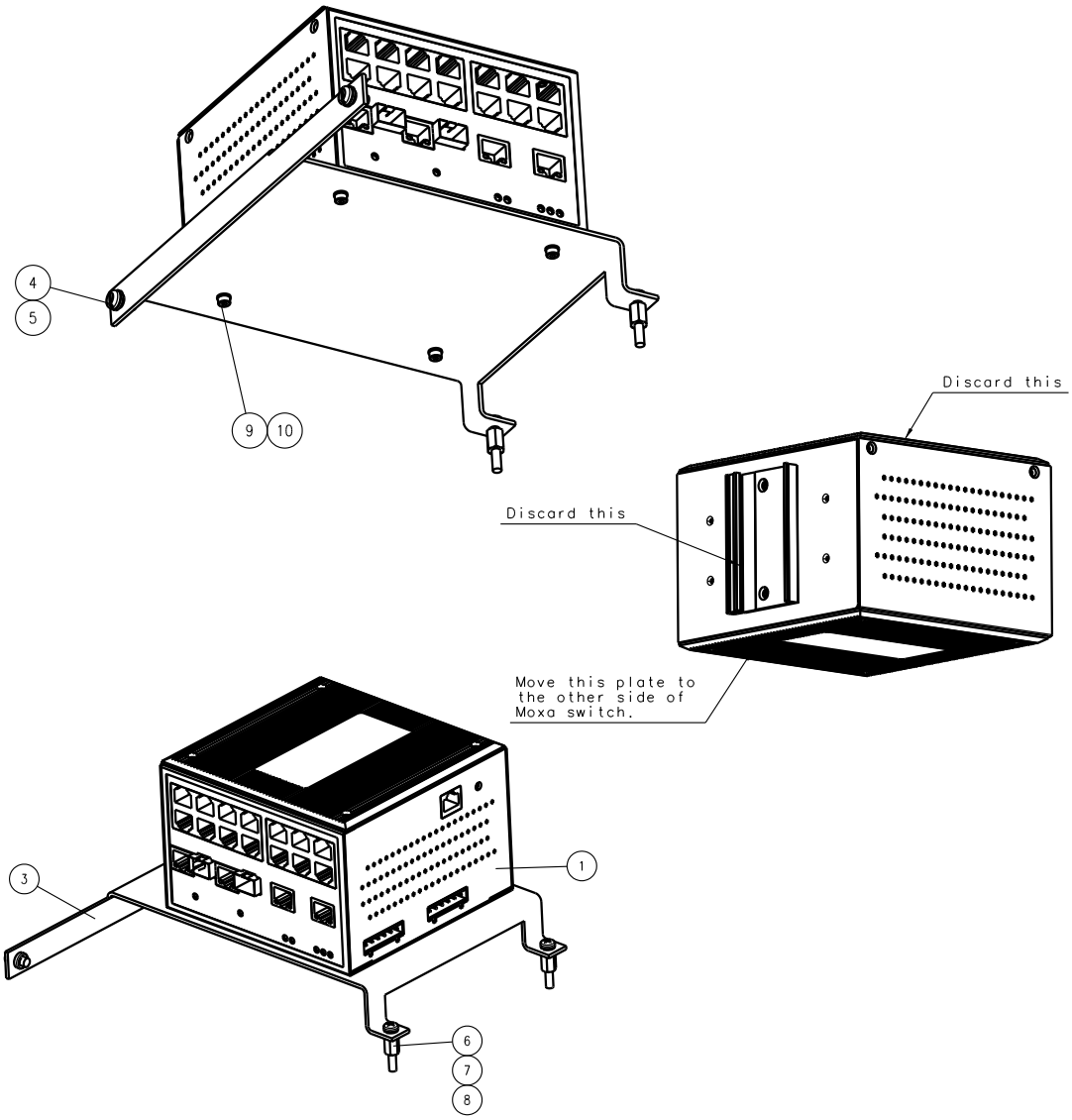


1. Mounting bracket
2. Support bracket
3. Desktop screw
4. Washer
5. Nut
6. Spring washer

Note:
The drawing is not in scale.

Cd31231 Page 1
348183 Rev. C

Moxa Switch

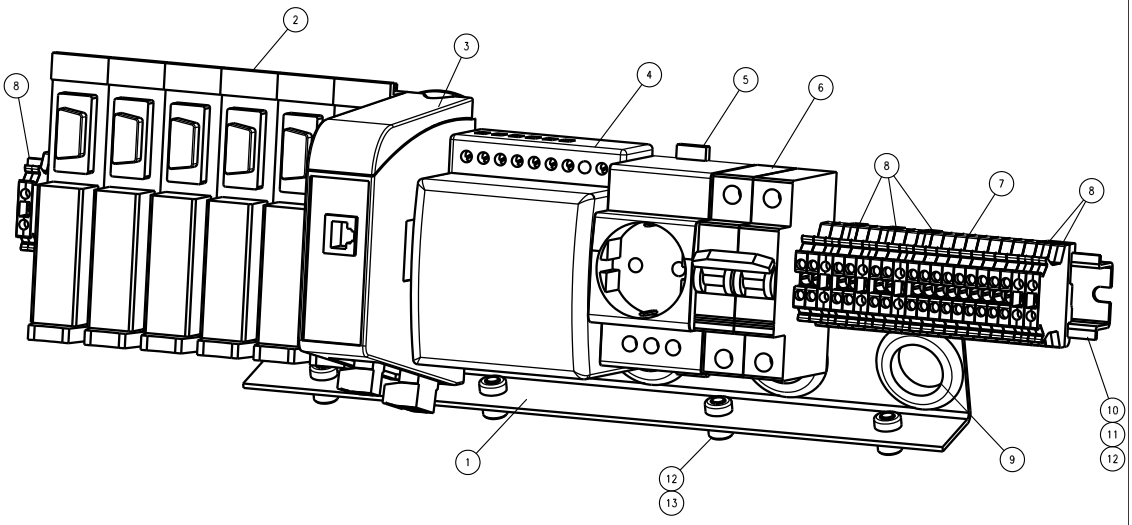


1. Ethernet switch
3. Mounting bracket
4. Washer
5. Spring washer
6. Screw
7. Spacer
8. Spring washer
9. Washer
10. Spring washer

Note:
The drawing is not in scale.

Cd31232 Page 1
349960 Rev. B

DIN-rail assembly

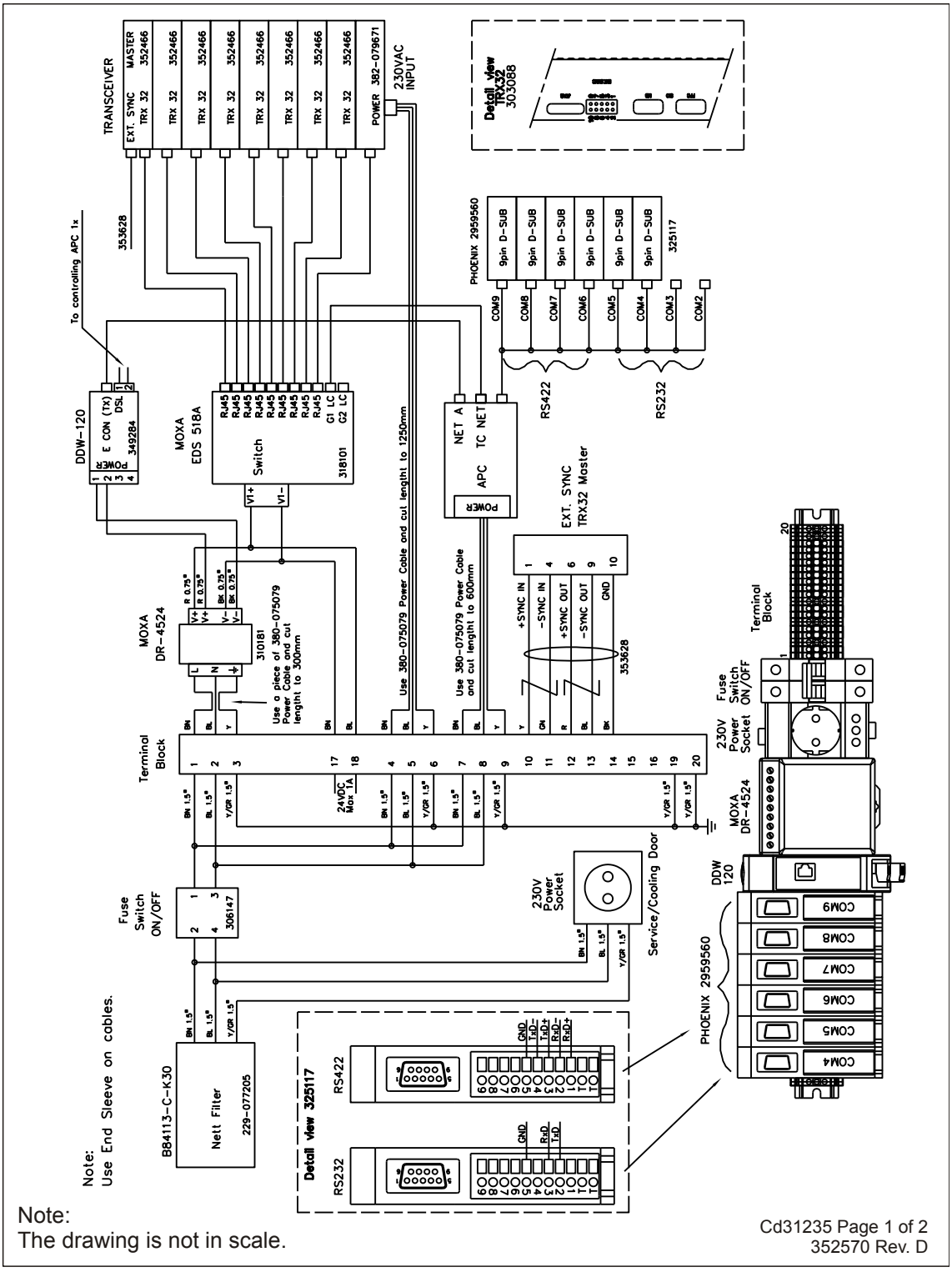


1. Connector plate
2. Module
3. Ethernet extender
4. Power supply
5. Power socket
6. Automatic fuse
7. Clamp
8. Clamp w/earth
9. Grommet
10. Mounting rail
11. Washer
12. Spring washer
13. Washer

Note:
The drawing is not in scale.

Cd31234 Page 1
352490 Rev. E

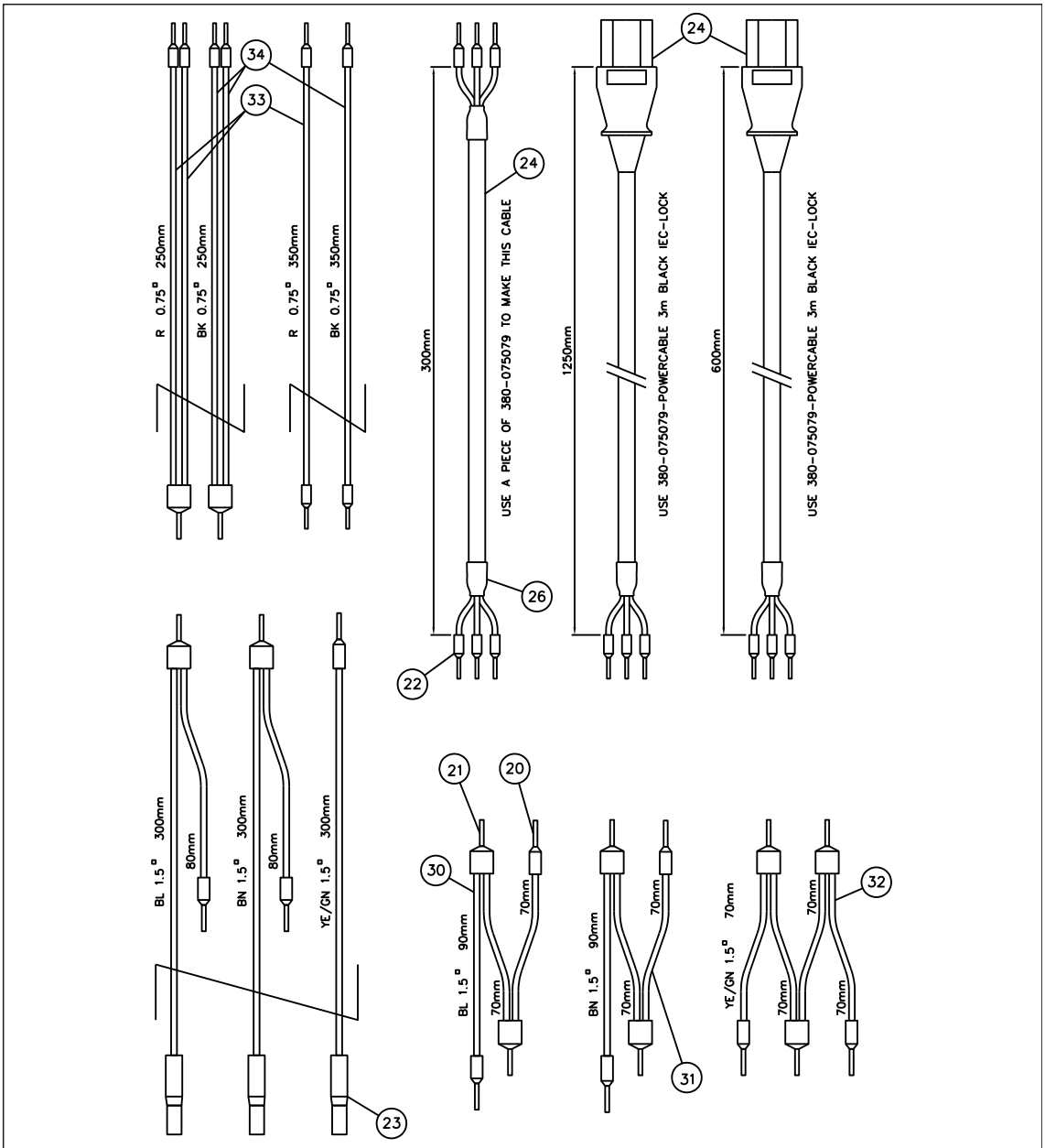
System wiring diagram - Page 1



Note:
The drawing is not in scale.

Cd31235 Page 1 of 2
352570 Rev. D

System wiring diagram - Page 2

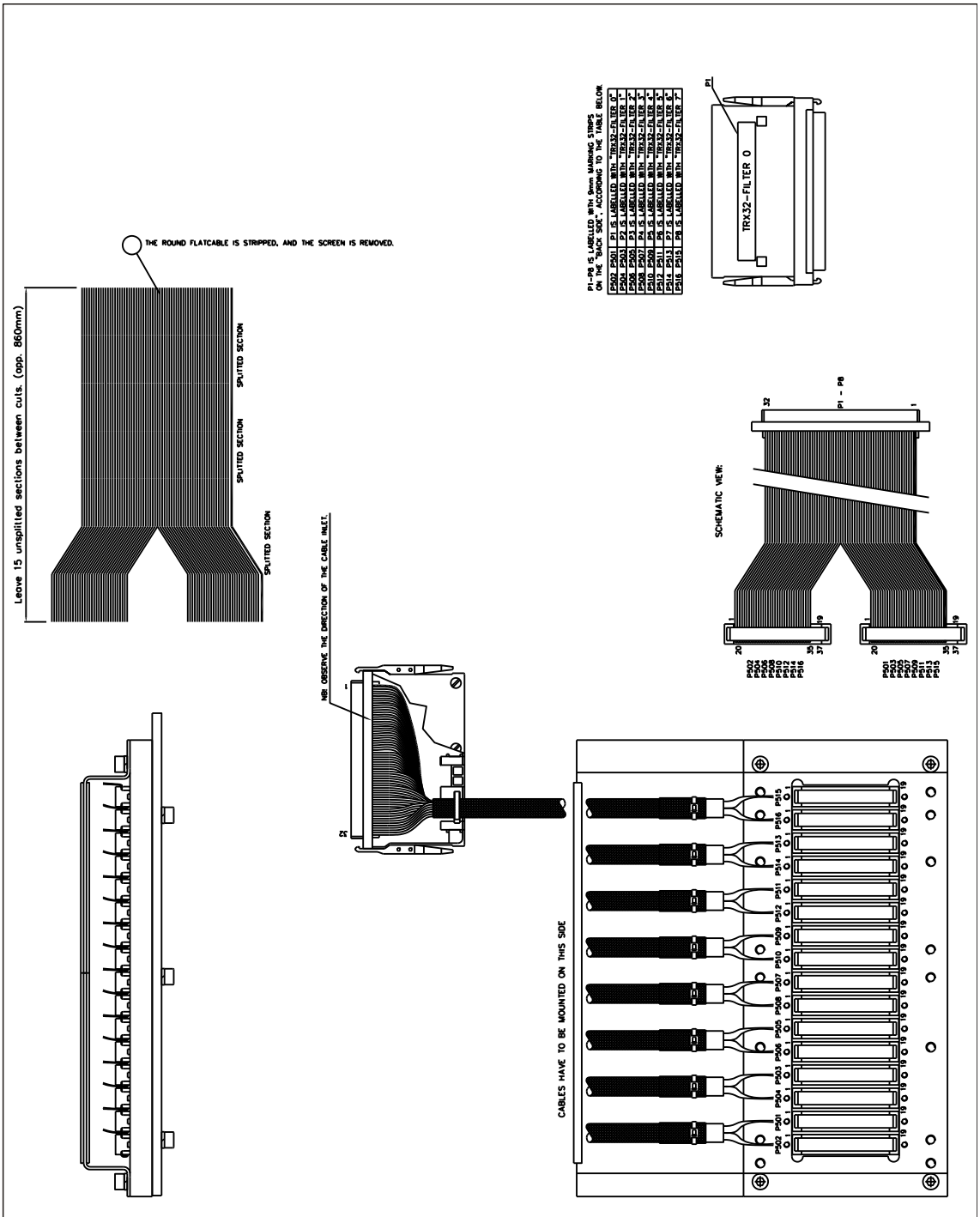


20. Sleeve
21. Sleeve
22. Sleeve
23. Spring washer
24. Power cable
30. Wire
31. Wire
32. Teflon wire
33. Wire
34. Wire

Note:
The drawing is not in scale.

Cd31235 Page 2 of 2
352570 Rev. D

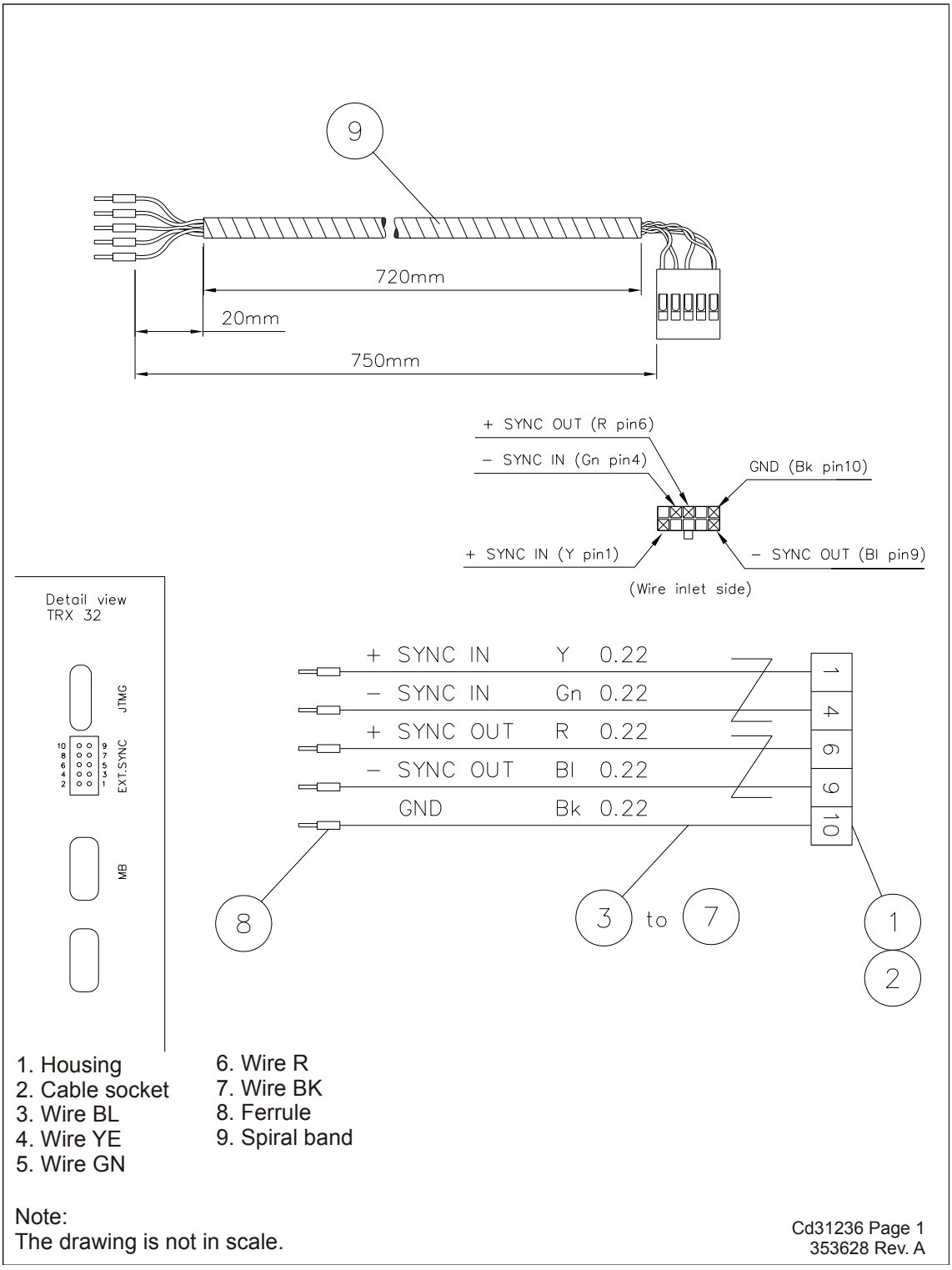
TD Plug conversion kit



Note:
The drawing is not in scale.

Cd31247 Page 1
352345 Rev. D

Responder Sync Cable



1. Housing
2. Cable socket
3. Wire BL
4. Wire YE
5. Wire GN
6. Wire R
7. Wire BK
8. Ferrule
9. Spiral band

Note:
The drawing is not in scale.

Cd31236 Page 1
353628 Rev. A

APC 1x RS-232 / RS-422 serial line cable

This cable comprises a multi-purpose serial line. It provides interface with any peripheral unit. One end of the serial line cable connects to the APC 1x with a 9-pin ’D’ connector.

The serial line cable is a split cable, with eight cables, one for each of the com port connectors. The com port connectors are labelled.

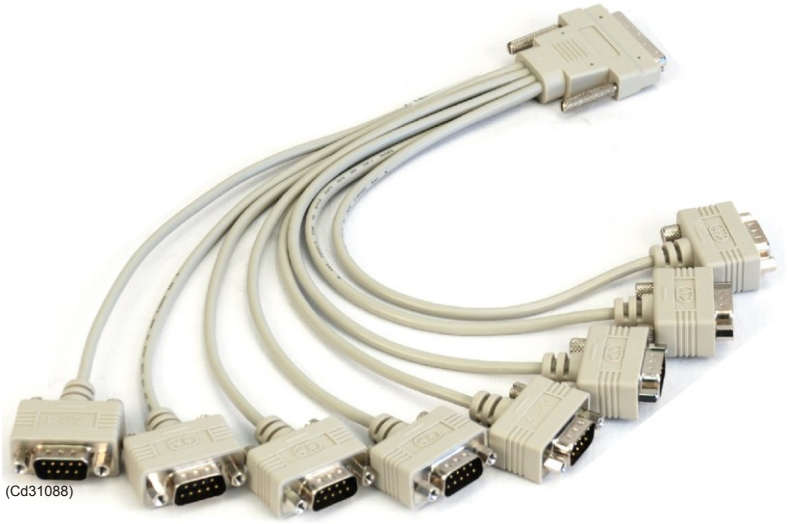
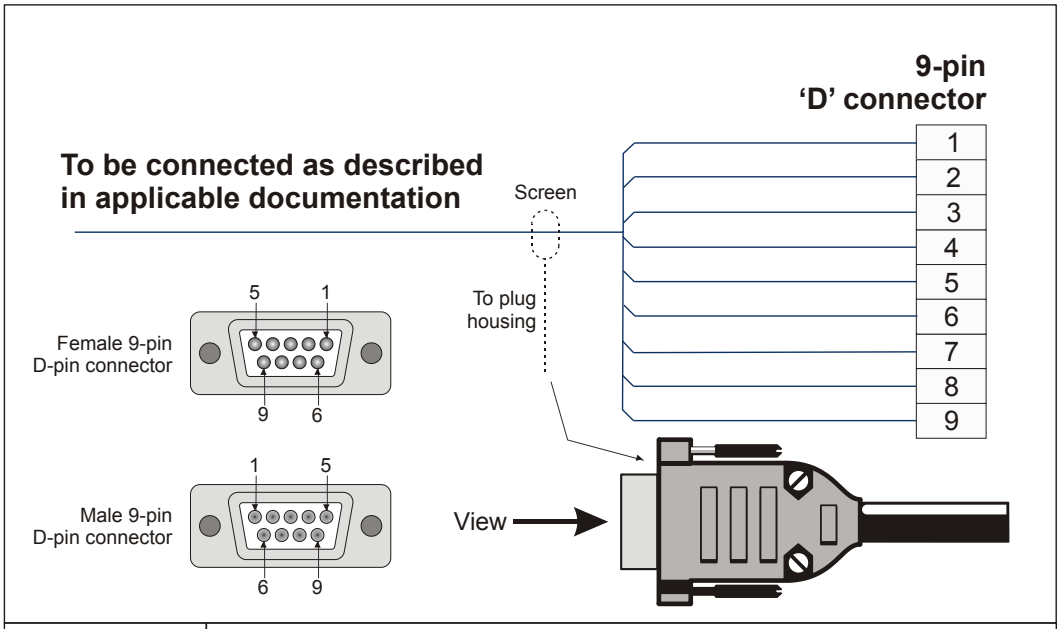


Figure 34 Serial lines cable

- PORT 1, PORT 2, PORT 3 and PORT 4 are RS-232
- PORT 5, PORT 6, PORT 7 and PORT 8 are RS-422

The other end (eight connectors) connects to the peripheral (DCE) as described in the peripheral unit’s documentation.



W127 Rev. B	Standard RS-232 or RS-422/-485 serial line

The pins are allocated as follows:

Pin no.	Signal RS-232	Signal RS-422	Pin no.	Signal RS-232	Signal RS-422
1	Carrier detect	Reception data +	2	Receive data	Transmission data +
3	Transmit data	Transmission data -	4	Data terminal ready	Reception data -
5	GND	GND	6	Data set ready	
7	Ready to send		8	Clear to send	
9	Ring indicator				

- Conductors: 6 x 2 x 0.5 mm^2
- Screen: Screened twisted pairs and overall braided
- Voltage: 60V
- Max. diameter: Set by plugs

14 INDEX

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Kongsberg HiPAP® 500/450/350 Retrofit
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